NUTRITIONAL FACTORS ASSOCIATED WITH HIV-INFECTED ADULTS IN THE FREE STATE

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by

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Thesis submitted in fulfillment of the requirements for the PhD Dietetics in the Faculty of Health Sciences, Department of Nutrition and Dietetics, University of the Free State

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BLOEMFONTEIN

DECLARATION OF INDEPENDENT WORK

DECLARATION WITH REGARD TO INDEPENDENT WORK

I, Michélle Pienaar, identity number 8011250075081 and student number 1999324864, do hereby declare that this research project, submitted to the University of the Free State for the degree PhD Dietetics: "Nutritional factors associated with HIV-infected adults in the Free State", is my own independent work, and has not been submitted before to any institution by myself or any other person in fulfillment of the requirements for the attainment of any qualification. I further cede copyright of this research in favour of the University of the Free State.

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SIGNATURE OF STUDENT DATE

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LIST OF ABBREVIATIONS

ADA	American Diabetes Association
AHA	Assuring Health For All
AIDS	Acquired Immune Deficiency Syndrome
ART	Antiretroviral therapy
ARV	Antiretroviral
ASSAf	Academy of Science of South Africa
AZT	Zidovudine
BMI	Body mass index
BP	Blood pressure
CCR5	chemokine receptor 5
CD4	Cluster of differentiation 4
CDC	Centers for Disease Control and Prevention
CI	Confidence interval
DDS	Dietary diversity score
DHHS	Department of Health and Human Services
DoH	Department of Health
DRI	Dietary Reference Intake
EFV	Efavirenz
FAO	Food and Agriculture Organisation
FBDG	Food Based Dietary Guideline
FS	Free State
FSRDPP	Free State Rural Development Partnership Programme
HAART	Highly active antiretroviral therapy
HbA1c	Glycated haemoglobin
HDL	High-density lipoprotein
HSRC	Human Sciences Research Council
HIV	Human Immunodeficiency Virus

IDF	International Diabetes Federation
INP	Integrated Nutrition Programme
INSTI	Integrase Strand Transfer Inhibitor
LDL	Low-density lipoprotein
LPV/r	Lopinavir/Ritonavir
MRC	Medical Research Council
MUAC	Mid-upper-arm-circumference
MUCPP	Mangaung University Community Partnership Programme
NASCOP	National AIDS and STI Control Programme
NFCS	National Food Consumption Survey
NHLS	National Health Laboratory Service
NRF	National Research Foundation
NRTI	Nucleotide Reverse Transcriptase Inhibitor
NNRTI	Non-Nucleoside Reverse Transcriptase Inhibitor
NVP	Nevirapine
PAL	Physical activity level
PEM	Protein energy malnutrition
PMtCT	Prevention of Mother-to-Child Transmission
PI	Protease Inhibitor
PURE	Prospective Urban Rural Epidemiology
RDA	Recommended Daily Allowance
RNA	Ribonucleic acid
SADHS	South African Demographic and Health Survey
SD	Standard deviation
Stats SA	Statistics South Africa
STD	Sexually transmitted disease
STI	Sexually transmitted infection
TB	Tuberculosis
TMP-SMZ	Trimethoprim-Sulfamethoxazole

THUSA	Transition in Health during Urbanisation of South Africans
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNICEF	United Nations Children's Fund
UFS	University of the Free State
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
VCT	Voluntary counselling and testing
WC	Waist circumference
WFP	World Food Programme
WHO	World Health Organisation

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Summary

HIV-infection has a significant impact on health and quality of life. Nutritional factors can be described as those directly related to food and nutrition (such as diet) and those indirectly related to food and nutrition (such as poverty). Dietary diversity is associated with improved socio-economic status and household food security, both of which impact on nutritional status and health. Poor nutritional status is characterised amongst other indicators, by fatigue, physical inactivity, weight loss and wasting, which are associated with poor prognosis in HIV-infection. All of these factors impact on people living with HIV/AIDS, but remain largely undetermined in the Free State.

The objective of the present study was to determine significant independent nutritional factors associated with HIV status in rural and urban communities in the cross-sectional Assuring Health for All (AHA) study, which aimed to determine how living in rural and urban communities can influence lifestyle and health.

The AHA study was undertaken in rural Trompsburg, Philippolis and Springfontein during 2007 and in urban Mangaung during 2009. Adults between 25-64 years were eligible to participate. The study was approved by the Ethics Committee of the Faculty of Health Sciences at the University of the Free State (ETOVS 21/07) as well as the Free State Department of Health and local municipalities. The venues where data was collected included stations for the collection of blood and urine samples; a food station; medical examination; as well as anthropometric measurements. Thereafter, questionnaires related to the following were completed: socio-demography (one per household); household food security (one per household); diet (one for each participant); physical activity (one for each participant); and reported health (one for every participant).

Logistic regression with forward selection ($p < 0.05$) was used to select significant independent factors (socio-demography, household food security, dietary diversity, physical activity, anthropometry, reported health) associated with HIV status. Variables with a p-value of < 0.15 were considered for inclusion in the model.

Of the 570 rural participants, 567 had HIV results. Of these 97 (17.1%) were HIV-infected. Of the 426 urban participants, 424 had HIV results. Of these 172 (40.6%) were HIV-infected. As expected, in rural areas, HIV-infected participants were significantly younger (median age 40.5 years) than HIV-uninfected participants (median age 51 years) (p = 0.001). The same was found in urban areas, with HIV-infected participants having a median age of 38 years compared to 49 years in HIV-uninfected participants (p = 0.0001). In this sample, the odds of having HIV consistently decreased as age increased. In rural areas more HIV-infected participants were female (73.0%) compared to male (27.0%). The same was found in urban areas where 78.0% of the HIV-infected respondents were women and only 22.0% men.

As far as socio-demographic and household food security indicators are concerned, in the rural sample HIV-infection was negatively associated with having a microwave oven (odds ratio 0.15, 95% CI 0.06; 0.42); having access to vegetables from local farmers or shops (odds ratio 0.43, 95% CI 0.21; 0.89); and being married (odds ratio 0.20, 95% CI 0.09; 0.41). On the other hand, HIV-infection was positively associated in the rural sample with spending less than R50 on food per week versus R101+ (odds ratio 3.29, 95% CI 1.58; 6.87) or spending less than R100 on food per week versus R101+ (odds ratio 1.22, 95% CI 0.68; 2.20). In the urban sample, HIV-infection was also negatively associated with being married (odds ratio 0.54, 95% CI 0.33; 0.89), while HIV-infection was positively associated with experiencing periods of food shortages (odds ratio 2.14, 95% CI 0.91; 0.95).

In the rural sample, one out of five participants had low and medium dietary diversity scores. HIV-infection was negatively associated with a person consuming no eggs (odds ratio 0.41, 95% CI 0.20; 0.82) and consuming no sweets (odds ratio 0.19, 95% CI 0.04; 0.85). On the other hand, HIV-infection was positively associated with being sedentary versus very active (odds ratio 3.18, 95% CI 1.31; 7.70); low active versus very active (odds ratio 2.27, 95% CI 1.08; 4.77); and active versus very active (odds ratio 2.44, 95% CI 1.31; 4.55). No significant dietary diversity or physical activity factors were identified in the urban sample.

As far as anthropometric indicators in the rural sample are concerned, HIV-infection was positively associated with a low versus high body fat percentage (odds ratio 15.56, 95% CI 0.80; 303.81); an acceptable low versus high body fat percentage (odds ratio 4.21, 95% CI 2.13; 8.31); and acceptable high versus high body fat percentage (odds ratio 1.85, 95% CI 0.81; 4.22). In the urban sample, HIV-infection was negatively associated with male gender (odds ratio 0.29, 95% CI 0.15; 0.53) and positively associated with a low or acceptable low versus high body fat percentage (odds ratio 9.18, 95% CI 4.89; 17.23) and acceptable high versus high body fat percentage (odds ratio 2.73, 95% CI 1.46; 5.12).

When indicators of reported health and coping strategies were considered, a negative association was found between being a member of a church and HIV-infection [odds ratio 0.22 (95% CI 0.06; 0.76) in the rural sample and odds ratio 0.46 (95% CI 0.23; 0.91) in the urban sample]. In rural areas, HIV-infection was positively associated with losing weight involuntarily (>3kg in the past 6 months) (odds ratio 1.86, 95% CI 1.08; 3.20); ever being diagnosed with TB (odds ratio 2.50, 95% CI 1.18; 5.23); being on TB treatment (odds ratio 3.29, 95% CI 1.00; 10.80); and having experienced death of a spouse during the past year (odds ratio 4.91, 95% CI 2.06; 11.73). In the urban sample, HIV-infection was positively associated with having diarrhoea for at least 3 days in the past 6 months (odds ratio 2.04, 95% CI 1.23; 3.41) and having ever been diagnosed with TB (odds ratio 2.49, 95% CI 1.37; 4.53).

When all factors identified above were considered for the final model, the odds of having HIV decreased as age increased. In rural areas, HIV-infection was negatively associated with microwave oven ownership (odds ratio 0.20, 95% CI 0.07; 0.57) and being married (odds ratio 0.17, 95% CI 0.08; 0.36). HIV-infection was positively associated with spending less than R50 per week on food versus R101+ (odds ratio 3.15, 95% CI 1.43; 6.95); having a body fat percentage of <5% versus 25%+ (odds ratio 4.41, 95% CI 1.69; 11.51); or having been diagnosed with tuberculosis (odds ratio 3.81, 95% CI 1.93; 7.52). In the urban sample, HIV-infection was negatively associated with male gender (odds ratio 0.29, 95% CI 0.15; 0.57). On the other hand, HIV-infection was positively associated with experiencing periods of food shortage (odds ratio 2.34, 95% CI 1.26; 4.37) and having a body fat percentage of <15% versus 25%+ (odds ratio 8.62, 95% CI 4.42; 16.84).

Lower socio-economic status [spending very little on food (rural); and food shortage (urban)], was positively associated with HIV-infection. Being physically inactive [indicated by being sedentary versus very active; low active versus very active; and active versus very active], was positively associated with HIV-infection in the rural sample of this study, probably because lower levels of physical activity are an outcome of HIV-infection. In addition, HIV-infection was positively associated with decreasing body fat percentage (rural and urban). These results confirm the higher prevalence of opportunistic infection and associated symptoms (such as diarrhoea and weight loss) that are outcomes of HIV-infection. Indicators related to wasting, previous tuberculosis and a lower socio-economic status [indicated by being female (urban) and unmarried (rural); spending very little on food (rural); and food shortage (urban)], were associated with HIV-infection, either as outcomes of the disease or as exposures.

A vicious cycle develops, with poverty increasing the likelihood of contracting HIV/AIDS and HIV/AIDS contributing to poverty. Interventions that focus on poverty alleviation can make a significant contribution to addressing HIV in South Africa. Interventions of this nature have the potential to improve food security and nutritional status which in turn will assist in preventing weight loss, promoting physical activity and improving quality of life. The social and moral support offered by organisations such as churches is invaluable in the fight against HIV.

Opsomming

MIV-infeksie het ’n beduidende impak op gesondheid en lewenskwaliteit. Voedingsfaktore kan beskryf word as dít wat direk verband hou met voedsel en voeding (soos dieet), en dit wat indirek verband hou (soos armoede). Dieetdiversiteit word geassosieer met verbeterde sosio-ekonomiese status en huishoudelike voedselsekuriteit, waarvan albei ’n impak op die individu se voedingstatus en gesondheid het. Moegheid, fisiese onaktiwiteit, gewigsverlies en wegkwyning is onder andere eienskappe van ’n swak voedingstatus. Hierdie tekens word geassosieer met ’n swak prognose in MIV-infeksie. Hierdie faktore wat die persone met MIV-infeksie beïnvloed bly grootliks onbepaald in die Vrystaat.

Die doel van die studie was om die beduidende onafhanklike voedingsfaktore, wat met MIV-status in die plattelandse en stedelike gemeenskappe in die dwarssnit Assuring Health for All (AHA)-studie gepaardgaan, te bepaal. Laasgenoemde studie het ten doel gehad om te bepaal hoe die lewe in plattelandse en stedelike gemeenskappe die individu se leefstyl en gesondheid kan beïnvloed.

Die AHA-studie is in landelike Trompsburg, Philippolis en Springfontein gedurende 2007 en in die stedelike Mangaung in 2009 onderneem. Volwassenes van 25 tot 64 jaar kon deelneem. Toestemming vir die uitvoering van die studie is verkry van die Etiekkomitee van die Fakulteit Gesondheidswetenskappe van die Universiteit van die Vrystaat (ETOVS 21/07) asook die Vrystaatse Departement van Gesondheid en plaaslike munisipaliteite. Die lokale waar data ingesamel is, het stasies vir die versameling van bloed en uriene; ‘n voedselstasie; mediese ondersoek; sowel as antropometriese metings ingesluit. Daarna is vraelyste in verband met sosio-demografie (een per huishouding); huishoudelike voedselsekuriteit (een per huishouding); dieet (een per deelnemer); fisiese aktiwiteit (een per deelnemer); en gerapporteerde gesondheid (een per deelnemer) voltooi.

Logistiese regressie met vorentoe seleksie ($p < 0.05$) is gebruik om beduidende onafhanklike faktore (sosio-demografies, voedselsekuriteit in die huishouding, dieetdiversiteit, fisiese aktiwiteit,

antropometrie en gerapporteerde gesondheid) wat geassosieer is met MIV-status, te bepaal. Veranderlikes met ’n p-waarde van < 0.15 is oorweeg om by die model in te sluit.

Van die 570 plattelandse deelnemers, het 567 MIV-resultate gehad. Van hierdie 567, was 97 (17.1%) MIV-geïnfekteer. Van die 426 stedelike deelnemers, het 424 MIV-resultate gehad. Van hierdie 424, was 172 (40.6%) geïnfekteer met MIV. Soos verwag, was MIV-geïnfekteerde deelnemers oorwegend jonger (mediaan-ouderdom van 40.5 jaar) as die MIV-ongeïnfekteerde deelnemers (mediaan-ouderdom van 51 jaar) (p = 0.001) in plattelandse gebiede. Dieselfde is bevind in die stedelike gebiede, met MIV-geïnfekteerde deelnemers met ’n mediaan-ouderdom van 38 jaar in vergelyking met 49 jaar by die MIV-ongeïnfekteerde deelnemers (p = 0.001). In hierdie steekproef het die waarskynlikheid om MIV te hê afgeneem soos wat ouderdom toegeneem het. In die plattelandse gebiede was daar meer vroulike MIV-geïnfekteerde deelnemers (73.0%) as mans (27.0%). Dieselfde is gevind in die stedelike gebiede waar 78.0% van die MIV-geïnfekteerde respondente vroue was met slegs 22.0% mans.

Wat sosio-demografiese en voedselsekuriteit-aanwysers betref, was MIV-infeksie in die plattelandse gebiede negatief geassosieer met die besit van ‘n mikrogolfoond (kansverhouding 0.15, 95% CI 0.06; 0.42), om toegang tot groente van plaaslike boere en winkels te hê (kansverhouding 0.43, 95% CI 0.21; 0.89) en getroud te wees (kansverhouding 0.20, 95% CI 0.09; 0.41). Hierteenoor was MIV-infeksie positief geassosieer as ‘n mens minder as R50 ’n week op kos versus R101+ spandeer (kansverhouding 3.29, 95% CI 1.58; 6.87) of R100 ’n week op kos spandeer versus R101+ (kansverhouding 1.22, 95% CI 0.68; 2.20). In die stedelike steekproef was MIV-infeksie ook negatief geassosieer met getroud wees (kansverhouding 0.54, 95% CI 0.33; 0.89). Hierteenoor was MIV-infeksie positief geassosieer met die ervaring van tydperke van voedseltekort (kansverhouding 2.14, 95% CI 0.91; 0.95).

In die plattelandse gebied het een uit elke vyf deelnemers lae en medium-voedseldiversiteit-tellings gehad. MIV-infeksie was negatief geassosieer met inname van geen eiers (kansverhouding 0.41, 95% CI 0.20; 0.82) en geen lekkergoed (kansverhouding 0.19, 95% CI 0.04; 0.85) ingeneem het nie. Hierteenoor was MIV-infeksie positief geassosieer met sittende versus baie aktief (kansverhouding 3.18, 95% CI 1.31; 7.70); lae aktief versus baie aktief (kansverhouding 2.27, 95% CI 1.08; 4.77); en aktief

versus baie aktief (kansverhouding 2.44, 95% CI 1.31; 4.55). Geen beduidende voedseldiversiteit- of fisiese aktiwiteits-faktore is in die stedelike steekproef geïdentifiseer nie.

Wat antropometriese aanwysers betref, was MIV-infeksie in die landelike steekproef positief geassosieer met lae versus hoë liggaamsvetpersentasie (kansverhouding 15.56, 95% CI 0.80; 303.81); 'n aanvaarbaar lae versus hoë liggaamsvetpersentasie (kansverhouding 4.21, 95% CI 2.13; 8.31); 'n aanvaarbaar hoë versus hoë liggaamsvetpersentasie (kansverhouding 1.85, 95% CI 0.81; 4.22). In die stedelike steekproef, was MIV-infeksie negatief geassosieer met die manlike geslag (kansverhouding 0.29, 95% CI 0.15; 0.53) en positief geassosieer met 'n lae of aanvaarbaar lae versus hoë liggaamsvetpersentasie (kansverhouding 9.18, 95% CI 4.89; 17.23) en 'n aanvaarbaar hoë versus hoë liggaamsvetpersentasie (kansverhouding 2.73, 95% CI 1.46; 5.12).

Wanneer aanwysers van gerapporteerde gesondheid en hanteringsmeganismes oorweeg is, is 'n negatiewe assosiasie gevind tussen kerk-lidmaatskap en MIV-infeksie [kansverhouding 0.22 (95% CI 0.06; 0.76) in die plattelandse steekproef en 0.46 (95% CI 0.23; 0.91) in die stedelike steekproef]. In die plattelandse gebiede was MIV-infeksie positief geassosieer met onvrywillige gewigsverlies (>3kg in die laaste ses maande) (kansverhouding 1.86, 95% CI 1.08; 3.20); om ooit met TB gediagnoseer te word (kansverhouding 2.50, 95% CI 1.18; 5.23); om op TB-behandeling te wees (kansverhouding 3.29, 95% CI 1.00; 10.80) en om die dood van 'n huweliksmaat die afgelope jaar te beleef (kansverhouding 4.91, 95% CI 2.06; 11.73). In die stedelike steekproef was MIV-infeksie positief geassosieer met diarree vir ten minste drie dae in die afgelope ses maande (kansverhouding 2.04, 95% CI 1.23; 3.41) en om voorheen met TB gediagnoseer te wees (kansverhouding 2.49, 95% CI 1.37; 4.53).

Nadat al die faktore, wat hierbo geïdentifiseer is, vir die finale model oorweeg is, het die MIV-waarskynlikheid afgeneem soos wat die ouderdom van deelnemers toegeneem het. In die plattelandse gebiede was MIV-infeksie negatief geassosieer met mikrogolfoond-eienaarskap (kansverhouding 0.20, 95% CI 0.07; 0.57) en om getroud te wees (kansverhouding 0.17, 95% CI 0.08; 0.36). HIV-infeksie was positief geassosieer met die spandering van minder as R50 versus R101+ per week op kos (kansverhouding 3.15, 95% CI 1.43; 6.95); om 'n liggaamsvetpersentasie < 5% versus 25%+

(kansverhouding 4.41, 95% CI 1.69; 11.51) te hê of om met TB gediagnoseer te wees (kansverhouding 3.81, 95% CI 1.93; 7.52). In die stedelike steekproef, was MIV-infeksie negatief geassosieer met manlike geslag (kansverhouding 0.29, 95% CI 0.15; 0.57). Hierteenoor was MIV-infeksie positief geassosieer met die ervaring van periodes van voedseltekort (kansverhouding 2.34, 95% CI 1.26; 4.37) en om ’n liggaamsvetpersentasie van < 15% versus 25%+ (kansverhouding 8.62, 95% CI 4.42; 16.84) te hê .

’n Laer sosio-ekonomiese status [om baie min aan kos te spandeer (plattelands); en voedseltekort (stedelik)] was positief geassosieer met MIV-infeksie. Om fisies onaktief te wees [aangedui deur sittend versus baie aktief; lae aktief versus baie aktief; en aktief versus baie aktief] was positief geassosieer met MIV-infeksie in die plattelandse steekproef van hierdie studie. Die rede hiervoor is waarskynlik omdat laer vlakke van fisiese aktiwiteit ‘n uitkoms van MIV-infeksie is. MIV-infeksie was ook positief geassosieer met afname in liggaamsvetpersentasie (plattelands en stedelik). Hierdie resultate bevestig die hoër voorkoms van opportunistiese infeksie en geassosieerde simptome (soos diarree en gewigsverlies) wat uitkomste van MIV-infeksie is. Aanwysers wat verband hou met wegkwyning, vorige tuberkulose en ’n laer sosio-ekonomiese status [aangedui deur vroulike geslag (stedelik) en ongetroud (plattelands); spandering van baie min op kos (plattelands); en voedseltekort (stedelik)], was geassosieer met MIV-infeksie, as uitkoms van die siekte of as blootstelling.

’n Bose kringloop ontstaan met armoede wat die waarskynlikheid om MIV/VIGS te kry laat toeneem asook MIV/VIGS wat weer tot armoede lei. Intervensies wat daarop fokus om armoede te verlig kan ’n aansienlike bydrae maak om MIV in Suid-Afrika aan te spreek. Intervensies van hierdie aard het die potensiaal om voedselsekuriteit en voedingstatus te verbeter, wat weer gewigsverlies kan voorkom, fisiese aktiwitiweit kan bevorder en lewensgehalte kan verbeter. Die morele en sosiale ondersteuning wat deur organisasies soos kerke aangebied word, is van onskatbare waarde in die stryd teen MIV.

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

"In the lifetime of the AIDS-epidemic, we have seen how one virus can change the course of history. Incredible transformation and deep entrenchment, AIDS has brought out the best and worst of humanity". This statement was made by Michel Sidibé, Executive Director of the Joint United Nations Programme on Human Immunodeficiency Virus (HIV)/ Acquired Immune Deficiency Syndrome (AIDS) (UNAIDS) (UNAIDS, 2011).

Globally, AIDS is an epidemic, severe and fatal disease (Suttajit, 2007) and is clearly the most significant public health crisis of our time (Simon *et al.*, 2006). In most countries in sub-Saharan Africa, the HIV/AIDS-epidemic is affecting decades of development (Vella, 2002). According to the Food and Agriculture Organisation (FAO) of the United Nations (2003), "the problems begin in households affected by HIV/AIDS, as soon as the first adult becomes sick". The *AIDS Epidemic Update of 2007*, published by UNAIDS and the World Health Organisation (WHO), estimates that 33.2 million people were living with HIV in 2007 (UNAIDS and WHO, 2007). With an estimated 5.5 million people infected, South Africa has the largest HIV-infected population in the world (UNAIDS and WHO, 2007). As stated by Chopra *et al.* (2009), "South Africans are facing new challenges fifteen years after liberation from apartheid. Challenges for which the best leadership, vision, and commitment is needed, because the effect of the unprecedented HIV/AIDS-epidemic has been immense".

AIDS is caused by a retrovirus known as the HIV (Dong and Imai, 2012:864), which attacks and weakens the body's natural defense system against disease and infection [United States Agency for International Development (USAID), 2008]. It is characterised by an acute syndrome with the primary infection, followed by a prolonged asymptomatic state eventually leading to advanced HIV-disease (Fauci and Lane, 2003) in which the virus steadily and persistently spreads [Academy of Science of South Africa (ASSAf), 2007:3]. Further evidence of illness may not be evident for as long as ten years

post-infection (Dong and Imai, 2012:866). This progression will depend on the general health and nutritional status of the individual before and after HIV-infection (Fenton and Silverman, 2008:998). Nutritional status plays an important role in maintaining a healthy immune system and delaying the progression of HIV to AIDS (Dong and Imai, 2012:864).

The rapid spread of HIV throughout South Africa has created a burden on the public healthcare delivery system (Chopra *et al.*, 2009). According to Majumdar and Mazaleni (2010), HIV/AIDS are a major concern in South Africa, where extreme poverty and gender issues are key determinants of health. HIV/AIDS mainly affect adults during their productive age, leaving the very young and old to cope alone (Lange and Van Der Waals, 2002). Hospitals and tertiary care facilities are becoming increasingly unable to care for HIV/AIDS patients. HIV can slow down economic growth, expand economic inequality, and cause severe burdens on affected households (UNAIDS, 2008). In order to compile strategies for prevention of illness and promotion of health, it is essential to understand the role played by socio-demographic, nutritional and health factors, all of which are closely associated with HIV and AIDS.

1.2 PREVALENCE OF HIV/AIDS

The first case of AIDS was described in 1981 [Centers for Disease Control (CDC), 1981]. Since then, the number of people living with HIV has gradually increased, leading to a global pandemic that affects socio-economic development worldwide (Dong and Imai, 2012:864). The majority of infections continue to occur in the developing world where more than 97% occur in low- and middle-income countries (UNAIDS and WHO, 2009).

1.2.1 HIV/AIDS: A global perspective

As stated by the UNAIDS and WHO (2009), “the continuing rise in the population of people living with HIV reflects the continued high rates of new HIV-infections”. At the end of 2008 an estimated 33.4 million [33.1 million–35.8 million] people were living with HIV or AIDS. At that time, there were 2.7

million new infections reported, an average of 7,400 infections daily. The total number of people living with the virus in 2008 was more than 20% higher than the number reported in 2000, and the prevalence was more or less threefold higher than in 1990. It is estimated that two million [1.7 million–2.4 million] deaths due to AIDS-related illnesses occurred worldwide in 2008. In that year, an estimated 2.7 million [2.4 million–3.0 million] new HIV-infections occurred and this prevalence was approximately 30% lower than at the epidemic's peak 12 years earlier. The most recent epidemiological data confirms that globally the spread of HIV appears to have peaked in 1996, when 3.5 million [3.2 million–3.8 million] new HIV-infections occurred (UNAIDS and WHO, 2009).

Table 1.1 provides a global summary of the AIDS-epidemic as given by UNAIDS and WHO (2009). The epidemic appears to have stabilised in most regions, although prevalence continues to increase in Eastern Europe and Central Asia and in other parts of Asia due to a high rate of new HIV-infections (UNAIDS and WHO, 2009). Increases in new infections are also being seen in higher-income countries in Eastern Europe such as Ukraine and the Russian Federation (Dong and Imai, 2012:865). The persisting rise in the population of people living with HIV is reflective of new HIV-infections and the widespread use of antiretroviral therapy (ART) which delays the progression of HIV-infection to death (Dong and Imai, 2012:864). Differences in the spread of HIV-infections are evident in all regions, with some national epidemics continuing to expand even as the overall regional HIV-incidence stabilises (UNAIDS and WHO, 2009).

AIDS-related mortality decreasing due to increasing access to ART has resulted in significantly fewer people dying of AIDS-related causes (WHO, 2010a). The number of people dying annually from AIDS-related causes worldwide decreased from a peak of 2.3 million [2.1 million–2.5 million] in 2005 to an estimated 1.7 million [1.6 million–2.0 million] in 2011 (WHO, 2010a). The impact of HIV-treatment is most evident in sub-Saharan Africa, where an estimated 550 000 (or 31%) fewer people died from AIDS-related causes in 2011 than in 2005, when the number of AIDS-related deaths peaked (WHO, 2010a).

Table 1.1: Global summary of the AIDS-epidemic (UNAIDS and WHO, 2009)

Global summary of the AIDS epidemic		December 2008
Number of people living with HIV in 2008	**Total**	**33.4 million [31.1 million–35.8 million]**
	Adults	31.3 million [29.2 million–33.7 million]
	Women	15.7 million [14.2 million–17.2 million]
	Children under 15 years	2.1 million [1.2 million–2.9 million]
People newly infected with HIV in 2008	**Total**	**2.7 million [2.4 million–3.0 million]**
	Adults	2.3 million [2.0 million–2.5 million]
	Children under 15 years	430 000 [240 000–610 000]
AIDS-related deaths in 2008	**Total**	**2.0 million [1.7 million–2.4 million]**
	Adults	1.7 million [1.4 million–2.1 million]
	Children under 15 years	280 000 [150 000–410 000]

The ranges around the estimates in this table define the boundaries within which the actual numbers lay, based on the best available information.

1.2.2 HIV/AIDS in Africa

According to Fawzi *et al.* (2005), "HIV-infection is having a devastating impact on people in developing countries". Sub-Saharan Africa remains the most profoundly affected region, accounting for 72% of all new HIV-infections in 2008 (UNAIDS and WHO, 2009). Most of the adults newly infected are still living in sub-Saharan Africa, but the number acquiring HIV-infection is declining (WHO, 2010a). The number of adults acquiring HIV-infection in 2011 in that region fell by more than 35% to 1.5 million [1.3 million–1.6 million] from the estimated 2.2 million [2.1 million–2.4 million] at the peak of the epidemic in 1997 (WHO, 2010a). In 2008, an estimated 1.9 million [1.6 million–2.2 million] people living in sub-Saharan Africa became newly infected with HIV, bringing the total number of people living with HIV to 22.4 million [20.8 million–24.1 million] (UNAIDS and WHO, 2009). As seen in Table 1.2, the rate of new HIV-infections in sub-Saharan Africa has also indicated a slow decline (UNAIDS and WHO, 2009). However, the number of people living with HIV in sub-Saharan Africa slightly increased in 2008, in part due to not improving access to HIV-treatment effectively. In adults (15–49 years), HIV-prevalence declined from 5.8% [5.5–6.0%] in 2001 to 5.2% [4.9–5.4%] in 2008. An estimated 1.4 million [1.1 million–1.7 million] AIDS-related deaths occurred in 2008 in sub-Saharan Africa. This number represents an 18% decline in annual HIV-related mortality in the region since 2004 (UNAIDS and WHO, 2009). Within sub-Saharan Africa, heterosexual transmission is the most prevalent mode of HIV-transmission (UNAIDS and WHO, 2009). Fewer people acquired HIV-infection

in sub-Saharan Africa in 2011 than in any year since 1997. An estimated 1.5 million [1.3 million–1.6 million] adults were newly infected with HIV in 2011, about 22% fewer than in 2001 and 3% fewer than in 2010.

Table 1.2: HIV/AIDS in sub-Saharan Africa (UNAIDS and WHO, 2009)

Number of people living with HIV	2008: 22.4 million [20.8 million–24.1 million]	2001: 19.7 million [18.3 million–21.2 million]
Number of new HIV-infections	2008: 1.9 million [1.6 million–2.2 million]	2001: 2.3 million [2.0 million–2.5 million]
Number of children newly infected	2008: 390 000 [210 000–570 000]	2001: 460 000 [260 000–640 000]
Number of AIDS-related deaths	2008: 1.4 million [1.1 million–1.7 million]	2001: 1.4 million [1.2 million–1.7 million]

The nine countries with the highest HIV-prevalence worldwide are all located in Africa, with each of these countries experiencing adult HIV-prevalence rates greater than 10% (UNAIDS and WHO, 2009). With an estimated adult HIV-prevalence of 26% in 2007, Swaziland had the most severe reported level of infection in the world (UNAIDS, 2008). Botswana had an adult HIV-prevalence of 24%, with some evidence of a decline in prevalence in urban areas (UNAIDS, 2008) where the percentage of 20-24 year-old antenatal clinic attendees who were HIV-infected fell from 38.7% in 2001 to 27.9% in 2007 (Botswana Ministry of Health, 2008). Lesotho's epidemic also appears to have stabilised, with an adult HIV-prevalence of 23.2% in 2008 (Khobotlo *et al.,* 2009:9). In Zimbabwe a steady fall in HIV-prevalence has been experienced since the late 1990s and studies have linked this decline with population-level changes in sexual behaviours (Gregson *et al.,* 2006). Data were also reported from Lusaka, where HIV-prevalence among young pregnant women (17 years or younger) declined from 12.1% in 2002 to 7.7% in 2006 (Stringer *et al.,* 2008). Evidence, however, indicates that HIV-incidence continues to rise in rural Angola (UNAIDS and WHO, 2009). There is a common belief that conflict increases the HIV/AIDS-epidemic, and as a result, refugees and internally displaced people fleeing humanitarian emergencies have a high prevalence of HIV-infection (Salama and Dondero, 2001; McGinn *et al.*, 2001; Hankins *et al.*, 2002), however, this assumption has been questioned (Spiegel, 2004; Allen, 2006).

For 2011, Statistics South Africa (Stats SA) estimates the mid-year population as 50.6 million (Stats SA, 2012). Blacks are in the majority (40.2 million) and constitute just more than 79.5% of the total South African population. The coloured population is estimated at 4,5 million (9%), the white population at 4.6 million (9%) and the Indian/Asian population at 1.3 million (2.5%). The South African National Prevalence, Incidence, Behaviour and Communication Survey by the Human Sciences Research Council (HSRC), was conducted from June 2008 to March 2009, and is the third in a series of national population-based surveys conducted for surveillance of the HIV-epidemic in South Africa (HSRC, 2004). South Africa's HIV-epidemic is defined by UNAIDS as "being a hyper-endemic epidemic as a result of the country having more than 15% of the population aged 15-49 years living with HIV" (Shisana *et al.*, 2009; UNAIDS, 2008), with approximately 5.7 million people infected (UNAIDS and WHO, 2009). According to Stats SA (2006), HIV-death rates have a typical pattern by age in which there is an increase at a certain age and then a rapid decline in older ages. Table 1.3 shows HIV-prevalence by age group in South Africa from the 2002, 2005, and 2008 surveys (Shisana *et al.*, 2009). These estimates provide valuable information based on the population-based survey that included children younger than two years of age, for the first time in 2008 (Shisana *et al.*, 2009). The 2008 national estimate of HIV-prevalence among South Africans of all age groups was 10.6%, which related to 5.2 million people of the total population being HIV-infected in 2008. Observations on HIV-prevalence of all people aged two years and older show stabilisation from 2002–2008 to 11% (Shisana *et al.*, 2009). Although the overall prevalence has stabilised, there are changes occurring in different age groups. There is still no evidence of a decline in infections among pregnant women in South Africa, where more than 29% of women accessing public health services tested positive for HIV in 2008 [Department of Health (DoH), 2009].

Table 1.3: HIV-prevalence by age, South Africa 2002, 2005 and 2008 (Shisana *et al.*, 2009)

Age	2002			2005			2008		
	n	%	95% CI	n	%	95% CI	n	%	95% CI
Children (2-14 years)	2 348	5.6	[3.7-7.4]	3 815	3.3	[2.3-4.8]	3 414	2.5	[1.9-3.5]
Youth (15-24 years)	2 099	9.3	[7.3-11.2]	4 120	10.3	[8.7-12.0]	3 617	8.7	[7.2-10.4]
Adults (≥ 25 years)	3 981	15.5	[13.5-17.5]	7 912	15.6	[14.2-17.1]	7 191	16.8	[15.3-18.4]
Total (≥ 2 years)	8 428	11.4	[10.0-12.7]	15 847	10.8	[9.9-11.8]	14 222	10.9	[10.0-11.9]
15-49 years	4 795	15.6	[13.9-17.6]	9 245	16.2	[14.9-17.7]	8 106	16.9	[15.5-18.4]

While national adult HIV-prevalence in South Africa has stabilised, prevalence among young people (15–24 years) started to decline in 2005, as shown among antenatal clinic attendees (from about 25% in 2004–2005 to 21.7% in 2008), as well as young men and women included in the national population based surveys (from 10.3% in 2005 to 8.6% in 2008) (Shisana *et al.,* 2009). However, the HIV-prevalence increased by 1.3% from 2002–2008 in adults aged 25 years and older. A similar trend is observed in the 15–49 year-old age group (Shisana *et al.*, 2009). Many HIV-deaths are registered as being due to some other cause of death (Stats SA, 2006), making it difficult to accurately determine the exact prevalence. This problem is worsened by the fact that HIV is not a reportable disease in South Africa, unlike some other communicable diseases (Stats SA, 2006).

1.3 PROBLEM STATEMENT

HIV/AIDS are often associated with physiological impairments and socio-economic changes that negatively affect nutritional status of the HIV-infected adult (Anabwani and Navario, 2005). As South Africa is undergoing major transformations, it is important to describe demographic, economic, health, as well as development trends that may play variable roles in nutrition and health (Steyn, 2006a), as well as in HIV-infection.

1.3.1 Demographic factors

Developing countries are undergoing major demographic shifts from rural to urban (MacIntyre *et al.,* 2002), and in South Africa, it is mainly the African population that is experiencing rapid urbanisation and the nutrition transition (Vorster *et al.*, 2007). Urbanisation is linked to changes in lifestyle, including dietary and activity patterns (MacIntyre *et al.,* 2002). Benefits of urbanisation may include lowering of infant mortality rates and longer life expectancies, as well as improved socio-economic conditions and the wider availability of foods. On the other hand, urbanisation may be associated with poorer living conditions. The relationship between socio-economic status and health is well documented, with higher income individuals generally receiving better healthcare than those with lower socio-economic status (UNAIDS, 2008). The co-existence of under- and overweight has been

well described for populations of the developing world that are experiencing the nutrition transition (Cabellero, 2006). Household surveys conducted in sub-Saharan Africa between 2001 and 2005 indicated that the median urban/rural ratio of HIV-prevalence is 1.7:1.0 (Garcia-Calleja *et al.*, 2006). In sub-Saharan African countries where household surveys have been conducted, HIV-prevalence is higher in rural areas only in Senegal (Central Statistics Office, Macro International, 2008). The most pronounced difference in HIV-prevalence is in Ethiopia, where urban dwellers are eight times more likely to be HIV-infected than people living in rural areas (Central Statistics Office, Macro International, 2008). A study performed in Kenya examined demographic, social, behavioral, and biological variables as risk factors for HIV-infection among men and women (Johnson and Way, 2006). It was found that people living in rural areas were half as likely to be HIV-infected compared to people living in urban areas.

In the South African National Prevalence, Incidence, Behaviour and Communication Survey, the definition of most-at-risk populations were expanded to include African females aged 20-34 years, African males aged 25-49 years, males older than fifty years, men who have sex with men, people who are high-risk drinkers, people who use drugs for recreational purposes, and people with disabilities (Shisana *et al.*, 2009). The results of the 2008 South African National HIV-survey indicated HIV-prevalence peaked in females aged 25-29 years at 32.7% and in males aged 30-34 years at 25.8% (Shisana *et al.*, 2009). One of the concerning findings of the 2008 survey is the sustained high levels of HIV-infection among young females (Shisana *et al.*, 2009). For example, among 15-19 year-olds, female prevalence is 2.7 times higher than that of males. In contrast to males, HIV-prevalence among females increased even more dramatically in subsequent age cohorts, reaching 21.1% among the 20-24 year-olds, and 32.7% among the 25-29 year-olds. By age 30-34 years the disproportions in HIV-prevalence were much smaller, although females still had a higher HIV-prevalence (Shisana *et al.*, 2009).

Data from the cross-sectional, population-based 2003 Kenya Demographic and Health Survey were used and the national HIV-prevalence in Kenya was found to be 6.7% (Johnson and Way, 2006). In the analysis of the study sample, uncircumcised men were four times more likely to be HIV-infected than

those who were circumcised. Compared with non-polygynous married women, widowed women, divorced women, and women who were one of three or more wives were all at higher risk for being HIV-infected (Johnson and Way, 2006). Men aged 35-44 years had the highest risk of being HIV-infected, whereas the ages of highest risk for women were 25-29 years (Johnson and Way, 2006).

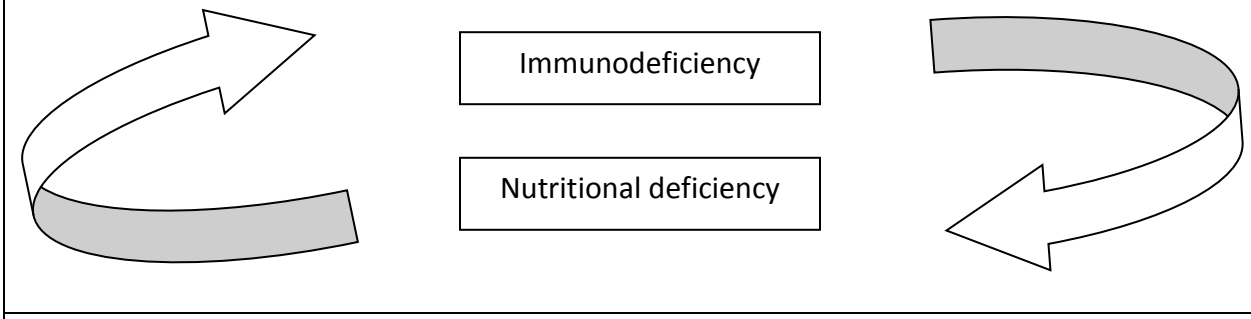
Increased wealth was positively related to risk for HIV-infection: the wealthiest women were 2.6 times more likely than the poorest women to be HIV-infected. A key finding was that both men and women who considered themselves to be at low risk for contracting HIV were, in fact, the most likely to be HIV-infected. The key demographic factor in this analysis was region: both men and women from the Nyanza Province had double the risk for HIV-infection compared to the respondents from Nairobi, the most densely-populated area in Kenya. The analysis demonstrates that HIV is an epidemic with many dimensions. Demographic, residential, social, biological, and behavioral factors all have an influence on individual probability of becoming infected with HIV (Johnson and Way, 2006).

1.3.2 Nutritional factors

For people living with HIV, adequate and balanced nutrition intake is essential to maintain a healthy immune system and prolong life (Dong and Imai, 2012:868). However, nutritional intake is often a neglected factor in the progression of HIV-disease. Weight loss and malnutrition are common in patients with HIV-infection or AIDS (Vorster *et al.,* 2004) and as stated by Tomkins (2002), likely to "accelerate disease progression, increase morbidity and reduce survival because of the well documented impact of malnutrition on immunity".

Proper nutrition may help maintain lean body mass, reduce the severity of HIV-related symptoms, improve quality of life, and enhance adherence and effectiveness of ART (Dong and Imai, 2012:868). Some common nutrition diagnoses in this population include: inadequate oral food and beverage intake; increased nutrient needs; swallowing difficulty; altered gastrointestinal function; food-medication interactions; involuntary weight loss; overweight and obesity; poor food- and nutrition-related knowledge; oversupplementation; impaired ability to prepare foods and meals; inadequate access to food; and, intake of unsafe foods (Dong and Imai, 2012:868).

Kim *et al.* (2001) found that there are definite associations between lifestyle and behavioural factors (e.g. dieting) and poorer nutrition in HIV-infected adults. Malnutrition and weight loss are important and complicated consequences of HIV-infection (Fenton and Silverman, 2008:1008) and are likely to accelerate disease progression, increase morbidity and reduce the odds for survival. Numerous studies have shown significant weight loss and high prevalence of underweight among HIV-infected adults (Oketch *et al.,* 2011:267). Malnutrition and HIV/AIDS can form a powerful cycle whereby malnutrition increases the susceptibility to infections and thus has a negative impact on the severity of the HIV/AIDS disease. Increased susceptibility to infections will contribute to a further deterioration of nutritional status (FAO, 2003). As seen in Figure 1.1, nutritional deficiency and immune deficiency, whether caused by HIV-infection or not, form a vicious cycle of supporting abnormalities (ASSAf, 2007:11).



"Infections with various microorganisms constitute the major burden of disease in the developing word, which also happens to be afflicted by inadequate food security and epidemics of under-nutrition. There has long been evidence of association between infectious disease and nutritional deficiency stages, and this is due to the synergies between immune deficiency and nutritional deficiency. HIV is exploding this vicious cycle on a shocking scale in the developing world, particularly in sub-Saharan Africa" (ASSAf, 2007:11).

Figure 1.1: Combining cause and effect of malnutrition (ASSAf, 2007:11)

There are several factors that can contribute to malnutrition in HIV/AIDS. Insufficient nutrient intake, increased requirements and increased nutrient losses are some of the most significant reasons for HIV/AIDS related wasting (FAO, 2003). In people infected with HIV, weight loss and loss of body cell mass are strong predictors of poor prognosis (ASSAf, 2007:141). These features are associated with increased resting energy expenditure, accelerated protein turnover, decreased energy intake,

diarrhoea and malabsorption and in most cases acute weight loss is associated with secondary infections (ASSAf, 2007:174).

Despite the efficacy of ART, wasting continues to be a common problem in the HIV-population that is not on ART (Dong and Imai, 2012:878). Factors that might contribute to wasting include inadequate dietary intake, malabsorptive disorders, metabolic alterations, hypogonadism and excessive cytokine production (Grinspoon and Mulligan, 2003). Malabsorption is a well established frequent feature in HIV-infection (Salas-Salvadó and García-Lorda, 2001) and is often suspected in the event of loose stools, diarrhoea, or vomiting. It also can also be caused by medications, opportunistic infections such as cytomegalovirus or cryptosporidiosis, or a developed intolerance to lactose, fat, or even gluten (Fenton and Silverman, 2008:1008).

Until the underlying cause of weight loss is discovered, it remains difficult to target effective nutrition therapy (Dong and Imai, 2012:878). Diarrhoea is a highly common complaint in patients with HIV-infection (Beatty, 2010), and the severity of symptoms ranges from mild, self-limiting diarrhoea to debilitating disease that can result in malnutrition, volume loss and shock.

HIV-infection is a complex and progressive disease in which several factors including HIV-itself, opportunistic infections, the host's immune system, and ARTs, are able to influence metabolic changes either directly or indirectly (Salas-Salvadó and García-Lorda, 2001), causing metabolic alterations. HIV-infection is marked by chronic oxidative stress (Duggan and Fawzi, 2001) (induced by the production of reactive oxygen species), which may play an important role in the stimulation of HIV-replication and the development of immunodeficiency (Suresh *et al.*, 2009).

Treatment of HIV is important as infections increase the need for nutrients, impair their absorption and result in a loss of appetite (FAO, 2003). Nutritional status should be assessed by integrating and evaluating information on nutrient intakes, nutritional anthropometry and biochemical markers of nutritional status, as well as clinical signs of malnutrition or nutritional deficiencies (ASSAf, 2007:20). These assessments provide the basis of nutritional counselling and decision-making about the need

for intervention such as food support and help to gain an understanding of the nutritional, medical, and physical status of people living with HIV/AIDS [National AIDS and STI Control Programme (NASCOP), 2007:53].

1.3.3 Health factors

The relation between nutrition and immunity is significant in HIV-infected individuals (ASSAf, 2007:133). In this context, poor nutrient status impairs an already compromised immune system, increasing vulnerability to opportunistic infections, which in turn leads to worsening of nutritional status (ASSAf, 2007:133). Opportunistic infections are often related to anorexia because of odynophagia, dysphagia, or abdominal pain that is associated with eating (ASSAf, 2007:124). The presence of comorbidities such as hepatitis, and opportunistic infections may complicate the patient's treatment profile (Dong and Imai, 2012:873). Opportunistic infections affecting the gastrointestinal tract, including the hepatobiliary system and the pancreas, may also result in various types of malabsorption (ASSAf, 2007:125). Advanced immunosuppression from HIV-infection can also lead to gastrointestinal symptoms such as diarrhoea, nausea, vomiting, dysphagia, weight loss, as well as abdominal pain (Hill and Balkin, 2009). In terms of respiratory abnormalities, pneumocystis pneumonia is the most common opportunistic pulmonary infection associated with HIV-infection (Atochina-Vasserman *et al.,* 2009).

HIV is a neurotropic virus causing neuronal damage independent of opportunistic infections (Kellinghaus *et al.,* 2006). As many as 60% of HIV/AIDS patients suffer from major depression, often characterised by a loss of satisfaction, overwhelming sadness and feelings of guilt (Baingana *et al.,* 2005). Depending on a patient's mental status, psychosocial issues may need to be addressed before nutrition counselling can be initiated (Dong and Imai, 2012:877).

Dermatological disorders are a frequent presenting feature of HIV-infection and/or AIDS (Grayson, 2008). Skin and mucosal diseases can be the first manifestation of asymptomatic HIV-infection, may indicate advancing immunodeficiency, or may represent systemic opportunistic infections or neoplasms (Ameem, 2010).

A review of overweight and obesity in HIV-infected individuals is also important (Dong and Imai, 2012:878) and will be discussed in further detail in Chapter 2. An increase in the incidence of noncommunicable diseases has been documented in the general population (MacIntyre *et al.,* 2002), but the presence of comorbidities such as heart disease, diabetes mellitus, hepatitis, and opportunistic infections may complicate the HIV-infected patient on ART treatment profile (Dong and Imai, 2012:873). It has been estimated that heart disease and type 2 diabetes mellitus are eighty to 90% preventable by changing one's lifestyle to include a balanced diet, a healthy body weight and regular exercise (Rolfes *et al.,* 2006:625). According to Dong and Imai (2012:877), the physical presentation of the patient on ART should be considered during initial and follow-up assessments. Physical changes may include HIV-associated lipodystrophy syndrome. Metabolic issues such as dyslipidemia and insulin resistance are common in people with HIV that are using ART (Dong and Imai, 2012:873) (these will be discussed in more detail in Chapter 2).

1.4 DIETARY DIVERSITY

A diet which is sufficiently diverse reflects nutrient adequacy (Kennedy, 2009). According to Labadarios *et al.* (2011), this statement is based on the fact that there is no single food which contains all required nutrients for optimal health.

Inadequate dietary diversity and food variety in poor populations in the developing world contributes to the problem of multiple nutrient deficiencies (Ruel, 2002). This might be due to high intake of starchy staples, and diets that often include little or no animal products and few fresh fruits and vegetables (Ruel, 2002). Dietary patterns are no longer only characterised according to intake of individual nutrients in order to determine an overall diet quality (Coulston, 2001). Dietary diversity and food variety are generally considered to be measurements of diet quality (Clausen *et al.*, 2005). The more food groups included in a daily diet the greater the possibility of meeting nutrient requirements (Labadarios *et al.*, 2011).

Various indices have been developed in an attempt to monitor a population's adherence to "healthy eating" dietary guidelines (Clausen *et al.*, 2005). Such quality indices include aspects of food variety. These are, however, complex to calculate, rely on quantified measurements of usual nutrient and food intake, and require healthcare workers with experience in nutritional science to analyse the data (Clausen *et al.*, 2005).

Food variety is usually quantified by the number of different food items (Bernstein *et al.*, 2002), whereas dietary diversity is usually quantified by the number of food groups (e.g. grains, meats, fruits, dairy products and vegetables) consumed over a certain period (Kant *et al.,* 1993). Although dietary diversity is defined as an outcome measure of food security at the individual or household level (Hoddinott and Yohannes, 2002), information related to food security and dietary diversity of the South African population is largely inadequate (Labadarios *et al.*, 2011). A study by Labadarios *et al.* (2011) measured dietary diversity in South Africans aged 16 years and older from all population groups as a necessity of food security. It was found that provinces with the highest prevalence of poor dietary diversity [dietary diversity score (DDS), <4] were Limpopo (61.8%) and the Eastern Cape (59.6%). By contrast, only 15.7% of participants in the Western Cape had a low score. Participants in tribal areas (63.9%) and informal urban areas (55.7%) were by far the worst affected. The majority of South Africans consumed a diet low in dietary diversity (Labadarios *et al.,* 2011).

Studies have shown that an increase in dietary diversity is associated with improved socio-economic status and household food security (household energy availability) (Hoddinot and Yohannes, 2002; Hatløy *et al*., 2000). In patients with HIV/AIDS, poor dietary intake often occurs in the presence of poverty and lack of food in the household (WHO, 2005b; Kirkpatrick and Tarasuk, 2008).

1.5 AIM AND OBJECTIVES

The Assuring Health for All in the Free State (AHA FS) study is a research project aimed at determining how living in rural and in urban areas influences the lifestyles of populations that predispose them to both chronic diseases (such as obesity, diabetes mellitus and cardiovascular disease), as well as undernutrition and HIV/AIDS. Contextual factors such as socio-economic status, dietary diversity, and household food security may impact on health and nutritional status (Oketch *et al.*, 2011:275). As South Africa is undergoing major transformations, it is important to describe the demographic, economic, health and development trends that may play important roles in nutrition and health (Steyn *et al.,* 2006a). The purpose of this part of the AHA study was to describe these in patients with and without HIV/AIDS. Data from the AHA FS project has the potential to identify nutritional factors associated with HIV/AIDS status, some of which may be considered as outcomes of HIV, while others may be considered as exposures.

1.5.1 Main aim

The main aim of the study was to identify nutritional factors associated with HIV status in adults living in rural and urban areas in the Free State.

1.5.2 Objectives

To describe the following in HIV-infected and uninfected individuals, in rural and urban areas:

- Socio-demographic profile and household food security;
- Dietary diversity and physical activity;
- Anthropometric characteristics; and,
- Reported health, medical and biochemical status.

To describe differences in the above factors in participants on and not on ART in HIV-infected urban participants.

To determine how the above nutritional factors (socio-demographic profile and household food security; dietary diversity and physical activity; anthropometric characteristics; and, reported health, medical and biochemical status), are associated with HIV status.

1.6 OUTLINE OF THESIS

Chapter 1:

Introduction

Chapter 2:

Epidemiology, Treatment and Management of HIV/AIDS

Chapter 3:

Methodology

Chapter 4:

Socio-Demographic Profile and Household Food Security of HIV-infected and HIV-uninfected Rural and Urban Communities in the Free State, South Africa

Chapter 5:

Dietary Diversity and Physical Activity of HIV-infected and HIV-uninfected Rural and Urban Communities in the Free State, South Africa

Chapter 6:

Anthropometric Status of HIV-infected and HIV-uninfected Rural and Urban Communities in the Free State, South Africa

Chapter 7:

Reported Health and Biochemical Profile of HIV-infected and HIV-uninfected Rural and Urban Communities in the Free State, South Africa

Chapter 8:

Nutritional factors associated with HIV status in Rural and Urban Communities in the Free State, South Africa

Chapter 9:

Conclusions and Recommendations

CHAPTER 2

EPIDEMIOLOGY, TREATMENT AND MANAGEMENT OF HIV/AIDS

2.1 INTRODUCTION

The natural history and classification of HIV, complications and adverse effects of HIV, as well as HIV screening and laboratory tests will very briefly be reviewed in this chapter. Since the main focus of this chapter is on factors associated with HIV status, these (socio-demographic status, household food security, nutrition, lifestyle factors, and physical activity) are discussed in more detail. Lastly, a brief overview of the assessment of nutritional status, management and prevention programmes is included.

2.2 NATURAL HISTORY AND CLASSIFICATION OF HIV

2.2.1 Etiology

AIDS was first described by the CDC in 1981 as "a surveillance definition based on signs, symptoms, infections, and cancers associated with the deficiency of the immune system that is a result of HIV-infection" (Fee and Brown, 2006; USAID/WHO, 2007). The first cases of AIDS were described in the same year (CDC, 1981). Soon after, HIV was isolated and identified as the important factor leading to AIDS (Dong and Imai, 2012:864).

The virus infects cells of the human immune system [mainly cluster of differentiation 4 (CD4) positive T-cells and macrophages: key components of the cellular immune system], and destroys or impairs their function (USAID/WHO, 2008; Dong and Imai, 2012:865). According to Dong and Imai (2012:866), HIV-infection causes a progressive depletion of CD4 cells, which eventually leads to immunodeficiency.

2.2.2 Pathogenesis of HIV-1

Entry of HIV into target cells is mediated by the viral envelope glycoprotein and its coordinated interaction with a receptor (CD4) and a co-receptor (usually the chemokine receptors CCR5 or CXCR4) (Ray and Doms, 2006). The two molecules on the HIV-1 envelope, the external glycoprotein (gp120) and the transmembrane protein (gp41), form the spikes on the virion's surface (Ray and Doms, 2006). CCR5 co-receptor antagonists prevent HIV-1 from entering and infecting immune cells by blocking the CCR5 cell-surface receptor (Briz *et al.*, 2006). Small molecule antagonists of CCR5 bind to a hydrophobic capsule formed by the transmembrane spirals of the CCR5 receptor (Murga *et al.*, 2006). These small molecules are thought to interact with the receptor, locking the receptor in a conformation that prohibits its co-receptor function (Watson *et al.*, 2005).

HIV enters host cells in the blood by attaching itself to receptors on the surface of the CD4 cell (Ray and Doms, 2006). Viral entry to the CD4 cell begins with attachment of the R5 HIV-1 glycoprotein 120 (gp120) to the CD4 T-cell receptor, which produces a conformational change in gp120 and allows it to bind to CCR5, thereby triggering glycoprotein 41 (gp41) mediated integration of the viral envelope with the cell membrane and the nucleocapsid enters the host cell (Figure 2.1) (Ray and Doms, 2006).

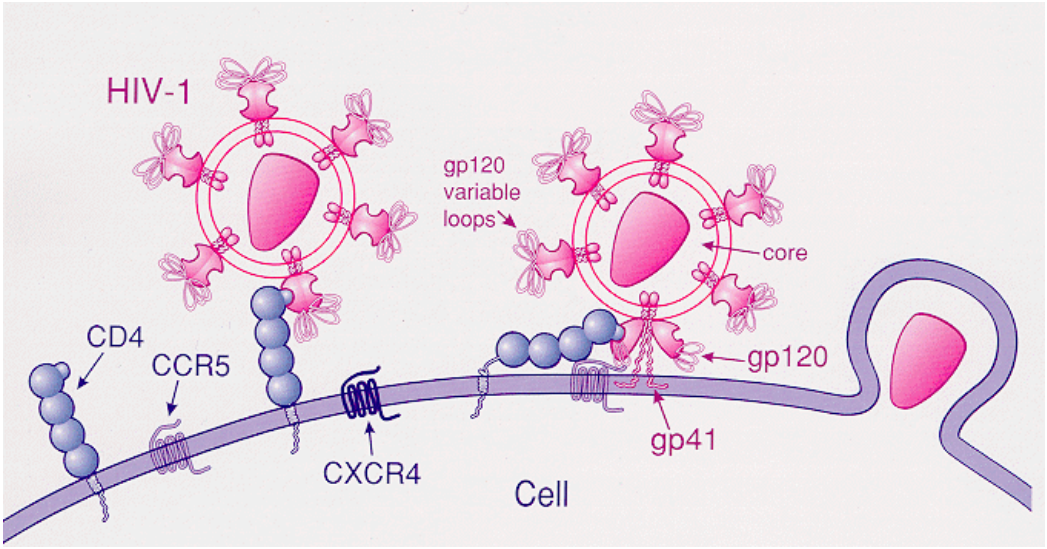


Figure 2.1: HIV entry into CD4 cell via CCR5 co-receptor (Ray and Doms, 2006)

2.2.3 Transmission of HIV

The HIV-1 life cycle is complex (Figure 2.2) and its duration and outcome is dependent on target cell type and cell activation (Coffin *et al.*, 1997). HIV is transmitted via direct contact with infected body fluids such as blood, semen, preseminal fluid, vaginal fluid, and breast milk (Dong and Imai, 2012:866).

2.2.3.1 Viral transmission

Independently of the transmission route, most new infections are established by viral variants that rely on CCR5 usage (Briggs *et al.,* 2006). The initial replication takes place in the regional lymph organs (e.g. draining lymph nodes) and consists of few viral variants, and leads to average primary expansion (Simon *et al.,* 2006) (Figure 2.2). With migration of infected T lymphocytes or virions into the bloodstream, secondary amplification in the gastrointestinal tract, spleen, and bone marrow results in massive infection of susceptible cells (Simon *et al.,* 2006).

Sexual transmission is the most common way that HIV is transmitted and injection drug use is the second most prevalent method of transmission (Dong and Imai, 2012:886). HIV is transmitted by both homosexual and heterosexual contact (Simon *et al.,* 2006), but heterosexual transmission continues to be the primary way of transmission and accounts for about 85% of all HIV-1-infections (Simon *et al.,* 2006). More than 340 million people contract a curable sexually transmitted infection (STI) each year, with women having greater exposure to infection than men (UNAIDS, 2008). Unsafe injections and contaminated blood transfusions in healthcare settings are still cause for concern (UNAIDS, 2008). Injection use is strongly linked with transmission of blood borne infections such as HIV, hepatitis B virus, and hepatitis C virus, especially if needles are reused or shared (Dong and Imai, 2012:868). Cerebrospinal fluid surrounding the brain and spinal cord, synovial fluid surrounding bone joints, and amniotic fluid surrounding a fetus are other fluids that can transmit HIV (Dong and Imai, 2012:866). Saliva, tears and urine do not contain enough HIV for transmission (Dong and Imai, 2012:866). The virus is not transmitted by casual contact such as touching, hugging, or kissing or through using the same plates, silverware or drinking glasses (Fenton and Silverman, 2008:994).

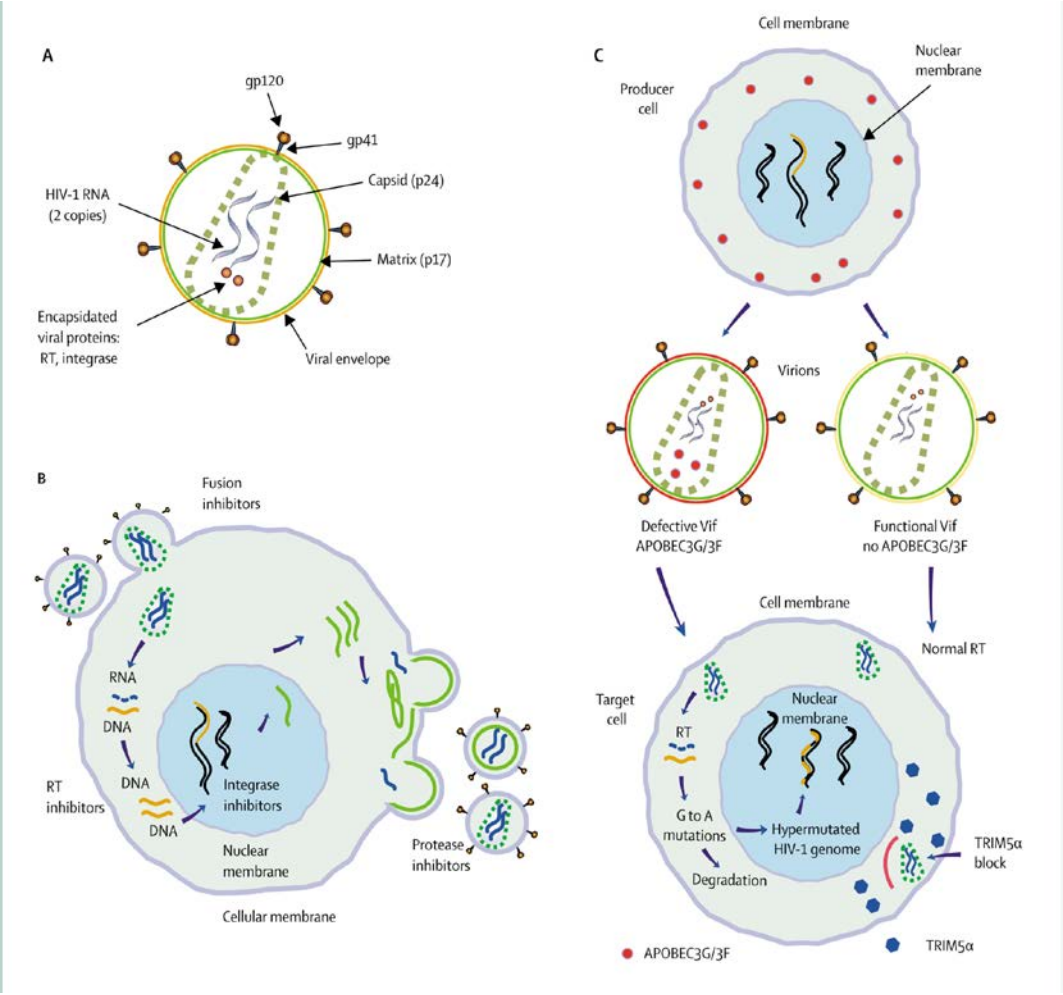


Figure 2.2: HIV-1 is a retrovirus that encodes three structural genes (Gag, Pol, and Env) (Simon et al., 2006)

(A) Envelope glycoproteins (gp120/41) form the spikes on the virion's surface. During maturation the gag protein is cleaved and Gag p24 forms the core. The viral genome, viral reverse transcriptase (RT), integrase as well as a number of host proteins are encapsidated.

(B) Steps of the viral life cycle on a cellular level and the potential targets for treatment interventions.

(C) HIV-1 has evolved strategies to counteract the restriction factors TRIM5α and APOBEC3G/3F. If left unchecked by HIV-1 Vif, APOBEC3G/3F is encapsidated into the egressing virion, and on infection of a target cell leads to G-to-A hypermutations in the viral genome. Rhesus TRIM5α inhibits HIV-1 replication early after infection of the target cell before the step of reverse transcription.

2.2.3.2 Mother-to-child transmission

An estimated 430,000 new HIV-infections occurred globally among children younger than the age of 15 in 2008 (UNAIDS and WHO, 2009). The majority of these infections are due to mother-to-child transmission in uteri, during delivery, or through consumption of HIV-infected breast milk (Dong and Imai, 2012:880). Maternal factors associated with increased overall risks for mother-to-child

transmission include high viral load, viral characteristics, advanced disease, immune deficiency and HIV-infection acquired during pregnancy or the breastfeeding period (Gray *et al.,* 2001). Recently, premastication (chewing foods or medicine before administering to a child) has been reported as a route of transmission through blood in saliva (CDC, 2011).

Infant feeding is one of the most critical links between HIV status and child survival (WHO, 2009a), although infant feeding in the context of HIV is complex due to the major influence that feeding practices have on child survival (WHO, 2009a). In exclusively breastfed children younger than five months, the risk for diarrhoea-related mortality is six-fold less and the risk for pneumonia-related mortality is 2.5-fold less than in infants that are not exclusively breastfed (Nannan *et al.,* 2007). Breastfed infants, therefore, have a reduced risk of infections such as diarrhoea and pneumonia due to the immune protection provided by breast milk and because they are not exposed to replacement milks that are often contaminated (Walker, 2009). The updated principles and recommendations of the WHO on infant feeding and HIV were revised in 2009 and include avoiding harm to infant feeding practices in the general population (WHO, 2009a). However, HIV has created great confusion among healthcare workers about the relative value of breastfeeding for the HIV-uninfected mother or whose HIV status is unknown. This led to the adoption of feeding practices (i.e. mixed feeding) with harmful results to infants (WHO, 2009a). The challenge is to balance the risk of infants acquiring HIV through breast milk with the higher risk of death from causes other than HIV (WHO, 2009a).

2.2.4 HIV and AIDS classification system for adults and adolescents

While HIV viral load is a major determinant, HIV-progression depends on complex interactions between viral and genetic host factors and differs among individuals (Fenton and Silverman, 2008:992). In Table 2.1 the revised WHO clinical staging of HIV and AIDS for adults and adolescents is described (WHO, 2005a).

Table 2.1: Revised WHO clinical staging of HIV and AIDS for adults and adolescents (WHO, 2005a)

Primary HIV-infection
Asymptomatic
Acute retroviral syndrome
Clinical stage 1
Asymptomatic
Persistent generalized lymphadenopathy (PGL)
Clinical stage 2
Moderate unexplained weight loss (<10% of presumed or measured body weight)
Recurrent respiratory tract infections (RTIs, sinusitis, bronchitis, otitis media, pharyngitis)
Herpes zoster
Angular cheilitis
Recurrent oral ulcerations
Papular pruritic eruptions
Seborrhoeic dermatitis
Fungal nail infections of fingers
Clinical stage 3
Conditions where a presumptive diagnosis can be made on the basis of clinical signs or simple investigations
Severe weight loss (>10% of presumed or measured body weight)
Unexplained chronic diarrhoea for longer than one month
Unexplained persistent fever (intermittent or constant for longer than one month)
Oral candidiasis
Oral hairy leukoplakia
Pulmonary tuberculosis (TB) diagnosed in last two years
Severe presumed bacterial infections (e.g. pneumonia, empyema, pyomyositis, bone or joint infection, meningitis, bacteraemia)
Acute necrotizing ulcerative stomatitis, gingivitis or periodontitis
Conditions where confirmatory diagnostic testing is necessary
Unexplained anaemia (< 8 g/dl), and or neutropenia (<500/mm3) and or thrombocytopenia (<50 000/ mm3) for more than one month
Clinical stage 4
Conditions where a presumptive diagnosis can be made on the basis of clinical signs or simple investigations
HIV wasting syndrome
Pneumocystis pneumonia
Recurrent severe or radiological bacterial pneumonia
Chronic herpes simplex infection (orolabial, genital or anorectal of more than one month's duration)
Oesophageal candidiasis
Extrapulmonary TB
Kaposi's sarcoma
Central nervous system (CNS) toxoplasmosis
HIV encephalopathy
Conditions where confirmatory diagnostic testing is necessary
Extrapulmonary cryptococcosis including meningitis
Disseminated non-tuberculous mycobacteria infection
Progressive multifocal leukoencephalopathy (PML)
Candida of trachea, bronchi or lungs
Cryptosporidiosis
Isosporiasis
Visceral herpes simplex infection
Cytomegalovirus (CMV) infection (retinitis or of an organ other than liver, spleen or lymph nodes)
Any disseminated mycosis (e.g. histoplasmosis, coccidiomycosis, penicilliosis)
Recurrent non-typhoidal salmonella septicaemia
Lymphoma (cerebral or B cell non-Hodgkin)
Invasive cervical carcinoma
Visceral leishmaniasis

2.2.5 Clinical manifestations of HIV-infection

The profile of HIV is constantly changing (Nixon *et al.,* 2002). HIV-infection progresses through four clinical stages: acute HIV-infection, asymptomatic HIV-infection, symptomatic HIV-infection, and progression of HIV to AIDS (Dong and Imai, 2012:866). For staging purposes, measurement of CD4 cells and viraemia is required (Simon *et al.,* 2006). The two main biomarkers used to assess disease progression are HIV ribonucleic acid (RNA) (viral load) and CD4 T-cell count (CD4 count) (Dong and Imai, 2012:866). The WHO clinical staging system has been widely used in poorer countries, particularly in the African region, and emphasises the use of clinical parameters to guide clinical decision-making for the management of HIV/AIDS patients (WHO, 2005a).

The four stages of HIV-infection, namely: acute HIV-infection, asymptomatic phase, symptomatic phase and AIDS, are in the following section.

2.2.5.1 Acute HIV-infection

The acute HIV-infection period includes the time from transmission of HIV to the host until the production of noticeable antibodies against the virus (seroconversion) occurs (Dong and Imai, 2012:866). Half of individuals experience physical symptoms such as fever, malaise, myalgia, pharyngitis, or swollen lymph glands two to four weeks following infection, but these symptoms generally decline after one to two weeks (Dong and Imai, 2012:866). During the acute stage, the virus replicates rapidly and causes a significant decline in CD4 cell counts (WHO, 2005a). Because of the nonspecific clinical features and short diagnostic window, acute HIV-infection is rarely diagnosed (Dong and Imai, 2012:866), but even in early infection in asymptomatic patients, HIV may lead to impaired nutritional status (FAO, 2003).

2.2.5.2 Clinical latency or asymptomatic phase

During the clinical latency or asymptomatic phase, the virus is still active and replicating; although at a decreased rate compared with the acute stage, and CD4 cell counts continue to substantially decline (Dong and Imai, 2012:866). In 3-5% of HIV-infected individuals, long-term non-progression occurs, in

which CD4 cell counts remain normal and viral loads can be undetectable for years without medical intervention [Dong and Imai, 2012:866; Department of Health and Human Services (DHHS), 2010].

2.2.5.3 Symptomatic phase

The symptomatic phase occurs when CD4 cell counts fall below 500 cells/cubic meter (mm^3) (Dong and Imai, 2012:866). Individuals are more prone to developing signs and symptoms such as persistent fevers, chronic diarrhoea, unexplained weight loss, and recurrent fungal and bacterial infections (Dong and Imai, 2012:866). Even if malnutrition is more frequent at the end stage of the disease, it can also occur at the onset of the chronic infection process, before severe immunodepression sets in (Salomon *et al.,* 2002).

2.2.5.4 AIDS

As immunodeficiency worsens and CD4 cell counts fall to even lower levels, the infection becomes symptomatic and progresses to AIDS (Dong and Imai, 2012:866). The CDC classifies AIDS cases as a positive laboratory confirmation of HIV-infection in persons with a CD4 cell count less than 200 cells/mm^3 (Table 2.2) or documentation of an AIDS-defining condition (Table 2.1) (Dong and Imai, 2012:866). This late-stage disease is characterised by the development of opportunistic infections, selected tumors, wasting and neurological complications (Bartlett and Gallant, 2003:1).

Table 2.2: CD4 levels and percentage in relation to the severity of immunosuppression in adults, children and infants (WHO, 2005a)

Immune status	Age		
	Up to 12 months CD4%	13-59 months CD4%	5 years or over CD4 count
Not significant immunosuppression	>35%	>25%	>500/mm^3
Mild immunosuppression	25-34%	20-24%	350-499/mm^3
Advanced immunosuppression	20-24%	15-19%	200-349/mm^3
Severe immunosuppression	<20%	<15%	<200/mm^3

2.3 HIV-SCREENING AND LABORATORY TESTS

HIV-testing, the first point of entry into HIV-care, has become steadily simpler to use and less expensive to deliver because of technological advances over the past decade (WHO, 2010a). In most cases, HIV-testing is initially by rapid test, either of blood through a finger-prick or a swab of saliva, with results available within thirty minutes. Various tests are used to diagnose HIV and the degree of disease progression, but CD4 count is used as the major indicator of immune function in people with HIV-infection (Dong and Imai, 2012:867). CD4 count is used to determine when to initiate ART and is the strongest predictor of disease progression. In addition, HIV RNA (viral load) is monitored on a regular basis because it is the primary indicator to check the efficacy of ART (Dong and Imai, 2012:867). Biochemical measurements should be documented to determine HIV-treatment, the need for ART, efficacy of the treatment, as well as underlying malnutrition and nutrient deficiencies (Dong and Imai, 2012:873). Some common biochemical measurements include CD4 count, viral load, albumin, hemoglobin, iron status, lipid profile, liver function, renal function, glucose, insulin, and vitamin levels (Dong and Imai, 2012:873). These technologies have made testing initiatives possible and have been used with success in South Africa (WHO, 2010a).

2.3.1 Adults and adolescents

CDC recommends that diagnostic HIV-testing should form part of routine clinical care in all healthcare settings. It is important to respect the patient's choice to decline HIV-testing and ensure a provider-patient relationship contributing to optimal clinical and preventive care (CDC, 2006b). Ideally, screening for HIV-infection should be performed routinely for all patients aged 13-64 years in healthcare settings (CDC, 2006b).

2.3.2 Pregnant women

HIV-screening should be a routine component of preconception care, maximising opportunities for all women to know their HIV status before conception (CDC, 2006a). In addition, screening early in pregnancy enables HIV-infected women and their infants to benefit from appropriate and timely interventions e.g. ART (Cooper *et al.,* 2002) and scheduled cesarean delivery (WHO, 2003). The South

African Prevention of Mother-to-Child Transmission (PMtCT) programme uses provider-initiated counselling and testing using on-site rapid HIV-testing (Black *et al.*, 2009).

2.4 ADVERSE EFFECTS

In this section the complications and adverse effects that can occur as a result of HIV/AIDS on the one hand, and the complications as a result of ART on the other will be discussed.

2.4.1 Adverse effects as a result of HIV/AIDS

Adverse effects as a result of HIV/AIDS that is not associated with highly active antiretroviral therapy (HAART) include a wide spectrum of manifestations, such as Kaposi's sarcoma, neurological complications, hepatitis C, tuberculosis (TB), oral candidiasis and renal disease.

Advanced immunosuppression from HIV-infection can lead to gastrointestinal symptoms such as diarrhoea, nausea, vomiting, dysphagia, weight loss, abdominal pain (Hill and Balkin, 2009), as well as gastrointestinal intolerance, peripheral neuropathy and rash (Fenton and Silverman, 2008:1001). Diarrhoea and weight loss are also common complications that will be discussed later in the chapter.

2.4.1.1 Neoplasms

Kaposi's sarcoma is cancer that causes abnormal tissue growth under the skin (Dong and Imai, 2012:876). Kaposi's sarcoma affects people with AIDS 20,000 times more frequently than the general population, and three hundred times more often than those with other immune disorders (Fenton and Silverman, 2008:1006). It manifests as purple nodules on the skin, mucous membranes, or lymph nodes or throughout the gastrointestinal tract. Individuals experience difficulty in chewing and swallowing caused by lesions in the oral cavity or esophagus (Dong and Imai, 2012:876). Diarrhoea or intestinal obstruction can also result (Dong and Imai, 2012:876).

2.4.1.2 Neurological complications

Individuals with HIV-infection often experience neurological complications, including cognitive deficits, referred to as HIV-associated neurocognitive disorders (Lawler *et al*., 2010; Kaul, 2008). This is due to HIV being a neurotropic virus that causes neuronal damage (Kellinghaus *et al.,* 2006). In recent years, HIV-related neurological disease has been increasingly recognised in resource-limited settings (Lawler *et al.,* 2010).

HIV-encephalopathy (AIDS dementia) is a degenerative disease of the brain caused by HIV-infection (Dong and Imai, 2012:876). According to WHO (2007), HIV-encephalopathy is a clinical finding of disabling cognitive and/or motor dysfunction interfering with activities of daily living, progressing over weeks or months in the absence of a concurrent illness or condition other than HIV-infection which might explain the findings. HIV-encephalopathy may lead to loss of coordination and cognitive function that can make activities, e.g. preparing food, difficult (Dong and Imai, 2012:876).

As many as 60% of HIV/AIDS patients suffer from major depression, often characterised by a loss of satisfaction, overwhelming sadness and feelings of guilt (Baingana *et al.,* 2005). According to Fenton and Silverman (2008:1010), psychosocial conditions (fear, anxiety, depression, and social isolation) all affect appetite and nutrient intake. Since advances in ART and other therapies now allow for a longer lifespan, even in those with histories of AIDS-defining illness, identifying the risk of depression has become increasingly important, even though the exact predictors of depression are still uncertain (Atkinson *et al.*, 2008).

2.4.1.3 Opportunistic infections

During the period of progression to AIDS, other viruses, bacteria, fungi and protozoa take advantage of the opportunity to further weaken the body, causing other illnesses (Fenton and Silverman, 2008:1034), including hepatitis C, TB and oral thrush. This explains the concept “opportunistic” which is used to refer to the infections and cancers commonly observed in HIV-infected individuals (Fenton and Silverman, 2008:1034).

i) Hepatitis C

Hepatitis C is viewed as an opportunistic infection (not an AIDS-defining illness) in HIV-infected persons, because it is associated with higher levels of the hepatitis C virus, more rapid progression to liver disease, and increased risk of cirrhosis (Matthews and Dore, 2008). Although it is unknown if the hepatitis C virus stimulates HIV-disease progression, it has been shown to damage the liver more rapidly in HIV-infected persons. Liver disease and liver enlargement are commonly present in HIV-infection, mostly in association with hepatitis C and B viruses and *Mycobacterium TB* (Terzic *et al.,* 2008). Liver function may be compromised by the infection with cytomegalovirus, herpes viruses infecting salivary glands, cryptosporidium, hepatitis B, hepatic malignant diseases, such as Kaposi's sarcoma or lymphoma (Fenton and Silverman, 2008:1006). In the presence of hepatic impairment, the metabolism and excretion of ART may be impaired, affecting the efficacy of HIV-treatment (Dong and Imai, 2012:868).

The medical management of hepatitis C in HIV-infected persons is complicated by immunosuppression, potential drug interactions and toxicities, and other forms of liver disease (Sulkowski and Thomas, 2003). Where possible, treatment of the hepatitis C virus is often advisable before HAART is required to avoid the issues of drug interactions on the hepatitis C virus therapy and the risk of HAART-related hepatotoxicity. Early diagnosis of both HIV and the hepatitis C virus-infection is essential to most effectively manage HIV-hepatitis C co-infected individuals (Matthews and Dore, 2008).

ii) Tuberculosis

HIV and TB co-infection remains a serious challenge (WHO, 2010a). In 2010, 8.8 million people acquired active TB worldwide, of which 1.1 million were living with HIV (WHO, 2010a). TB is one of the most commonly notified diseases in South Africa, with more than 80% of people living with HIV and TB occurring in sub-Saharan Africa (WHO, 2010a). The global burden of TB is increasing, largely due to the spread of HIV/AIDS (ASSAf, 2007:35), but these statistics can also be ascribed to other contributing factors such as crowding, poverty, unemployment, malnutrition, HIV-infection, poor health standards affecting diagnosis and poor treatment intervention (ASSAf, 2007:34). The HIV-

epidemic has worsened the current TB-epidemic worldwide and in particular in sub-Saharan Africa (Chaisson and Martinson, 2008) and the mortality in patients co-infected with TB and HIV is high (Mugusi *et al.*, 2009).

The most common infection route for TB is inhalation of a very small number of droplet nuclei containing virulent tubercle bacilli (Black, 2003) and an infection can develop in most exposed individuals who are otherwise healthy (ASSAf, 2007:98). Although most cases of TB caused by *Mycobacterium TB* affect the lungs (Dong and Imai, 2012:876), the disease may also occur in extrapulmonary sites such as in the larynx, lymph nodes, brain, kidneys, or bones (Fenton and Silverman, 2008:1006).

TB may lead to prolonged fatigue, anorexia, nutrient malabsorption, altered metabolism, and weight loss (Dong and Imai, 2012:876). Nutritional deficiencies, in particular, are known to worsen immunological mechanisms that are crucial for successful control of mycobacteria, namely the functions of T-lymphocytes and a variety of phagocytic cells (North and Jung, 2004). Malnutrition may predispose to TB; however, TB also worsens malnutrition. Some of the important signs and symptoms of TB (e.g. wasting, anemia, loss of lean and fat mass, etc.) are also signs of malnutrition (ASSAf, 2007:155). Nutritional deficiencies are thus generally associated with increased risk and severity of TB (ASSAf, 2007:151).

Action to decrease HIV and TB-infection is increasing, but needs to accelerate further (WHO, 2010a). Reducing mortality figures will require increasing TB cure rates from 70-85%, detecting at least 80% of TB cases among people living with HIV (WHO, 2010a).

iii) Oral candidiasis

Oral candidiasis associated with HIV-infection also occurs commonly and recurs frequently, and presents often as an initial manifestation of HIV (Pienaar *et al.,* 2006). Oral lesion is an early marker for HIV-infection (Nelwan and Wisaksana, 2010) and if left untreated, these lesions might increase the risk of morbidity associated with HIV-infection (Fenton and Silverman, 2008:1014). Oral lesions are

often the first sign of HIV-infection that lead to diagnosis and can mark immunodeficiency and disease progression (Fenton and Silverman, 2008:1014). Candidiasis is an infection caused by fungi or yeast leading to oral mouth sores, difficulty chewing and swallowing and changes in taste (Dong and Imai, 2012:876). Typical appearance of oral candidiasis is white patchy plaque in oral mucous membranes or the tongue (Nelwan and Wisaksana, 2010).

iv) Renal disease

Another possible result of HIV/AIDS infection is a syndrome of progressive renal failure, or HIV-associated nephropathy (Fenton and Silverman, 2008:1006). Important risk factors for kidney disease in this population include black race, older age, hypertension, diabetes mellitus, low CD4 cell count, and high viral load (Winston *et al.*, 2008). Before effective ART became available, HIV-associated nephropathy was frequent and its clinical features were dramatic. This included proteinuria and rapid progression to end-stage renal disease in immunosuppressed persons and HIV-associated nephropathy became almost synonymous with HIV-associated chronic kidney disease (Winston *et al.*, 2008). Deaths from kidney disease have increased, as have the number of dialysis centers serving HIV-infected patients (Fenton and Silverman, 2008:1006). The aging of an HIV-infected population is another important pathway by which the incidence of chronic kidney disease can be expected to continue to increase (Winston *et al.*, 2008).

v) Dermatological disorders

Dermatological disorders are a frequent presenting feature of HIV-infection and/or AIDS (Grayson, 2008). More than 90% of HIV-infected patients will suffer from one or more skin diseases during the course of their illness (Grayson, 2008).

Dermatologic manifestations in AIDS-patients act as markers of disease progression (Cedeno-Laurent *et al.*, 2011). Skin and mucosal diseases can also be the first manifestation of asymptomatic HIV-infection (Ameem, 2010). Cutaneous disorders associated with HIV type-1 infection can be classified as primary and secondary (Cedeno-Laurent *et al.*, 2011). The dominant HIV-associated skin diseases are infectious and inflammatory and they can cause significant morbidity (Ameen, 2010).

Mucocutaneous diseases are highly prevalent in the HIV-infected population and multiple pathologies are common particularly with advanced immunosuppression (Patel and Weinberg, 2008). Skin and mucosal diseases may indicate advancing immunodeficiency, or may represent systemic opportunistic infections or neoplasms (Ameem, 2010). Clinical presentations are often atypical and may vary depending on the level of immunosuppression (Ameen, 2010).

Conditions such as atopic dermatitis, psoriasis, and seborrheic dermatitis are extremely common dermatologic problems expressed in the general population; but, the direct role of HIV in the pathogenesis of these manifestations is still uncertain (Cedeno-Laurent *et al.*, 2011). Despite the significant decline in HIV-related skin diseases with ART, the drugs have also resulted in a range of other skin-associated problems: adverse effects, an increased risk of drug reactions, and immune reconstitution-associated skin diseases (Ameen, 2010).

2.4.2 Adverse effects of antiretroviral therapy

Because the elimination of HIV is not yet possible, and the need for treatment is lifelong, adverse effects of medications, including metabolic complications and other toxicities, have become increasingly prevalent (Dong and Imai, 2012:867). HIV-related death from opportunistic infections has shifted to other chronic disease conditions such as heart disease and diabetes mellitus in healthier individuals who are living with HIV (Leyes, 2008). Acute complications of ART include diarrhoea, fatigue, gastroesophageal reflux, nausea, vomiting and lactic acidosis. Long-term/chronic complications of ART include obesity, glucose and lipid metabolism disorders, fat redistribution, cardiovascular disease and bone mineral loss.

2.4.2.1 Acute adverse effects of antiretroviral therapy

Certain ART medications may cause acute adverse effects such as gastrointestinal side-effects (including bloating, flatulence, nausea and diarrhoea), hypersensitivity with rash and central nervous system disturbances (dizziness, depression and sleep disturbances) (WHO, 2010a).

Common adverse effects occurring early in most ART include gastrointestinal effects such as bloating, nausea and diarrhoea, which may be temporary or may persist throughout therapy (Carr and Cooper, 2000). Other common adverse effects are fatigue and headache caused by zidovudine (AZT) and nightmares associated with efavirenz (EFV). Rash is a common adverse effect of the nonnucleoside reverse transcriptase inhibitors (NNRTIs), particularly nevirapine (NVP). Approximately 16% of patients taking NVP experience a mild to moderate maculopapular rash, with or without pruritus, on the trunk, face and extremities, within the first six weeks on therapy (Dybul *et al.*, 2002).

Lactic acidosis is another serious metabolic complication with potential to result in hepatic failure and death (Salomon *et al.,* 2002). Lactic acidosis is defined as a lactate level < 5 millimole per liter (mmol/L) and a pH < 7.34 and/or a serum bicarbonate level < 18 mmol/L (Bolhaar and Karstaedt, 2007). In a study undertaken in Soweto, South Africa, by Bolhaar and Karstaedt (2007), the incidence of lactic acidosis and symptomatic hyperlactatemia by sex were evaluated, clinical features were analysed, and the safety of reintroducing HAART with AZT replacing stavudine were described. Almost 35% of the patients were initiating HAART. The patients presented predominantly with gastrointestinal symptoms (87%), loss of weight (73.9%), and dyspnea (56.6%). The study found that women that participated had a higher frequency of symptomatic hyperlactatemia and lactic acidosis than has been reported for patients in other study groups.

2.4.2.2 Chronic adverse effects of antiretroviral therapy

Long-term complications caused by ART include overweight and/or obesity, fat redistribution syndrome, noncommunicable diseases and bone mineral loss.

i) HIV and obesity

Unintentional weight loss in HIV-infection has been associated with mortality, but a review of overweight and obesity in HIV-infected individuals is also important (Dong and Imai, 2012:878). In the general South African adult population, the malnutrition pattern is predominately one of overnutrition (Puoane *et al.,* 2002; Steyn, 2006b; Vorster *et al.*, 2007).

ART medications increase the risk of developing hyperlipidemia, insulin resistance, and diabetes mellitus (Dong and Imai, 2012:878). Glucose and lipid toxicity, associated with insulin resistance, play roles in the pathogenesis of the co-morbid diseases of obesity (Kruger *et al.,* 2005). Insulin resistance appears to be an important factor in black South African patients with hypertension, obesity and diabetes mellitus (the metabolic syndrome) (Buthelezi *et al.*, 2000; Van Der Merwe *et al.*, 1998; Van Der Merwe *et al.*, 1999; Van Der Merwe *et al.*, 2001; Punyadeera *et al.*, 2001a; Punyadeera *et al.*, 2001b). Insulin resistance in HIV-infected patients on HAART appears to be a consequence of insulinopenia and elevated free fatty acids from enhanced lipolysis (Buthelezi *et al.*, 2000; Van Der Merwe *et al.*, 1998; Van Der Merwe *et al.*, 1999; Van Der Merwe *et al.*, 2001; Punyadeera *et al.*, 2002; Punyadeera *et al.*, 2001b; Van Der Merwe *et al.*, 1996). Being overweight or obese is associated with a number of health risks, including hypertension and dyslipidaemia (Crum-Cianflone *et al.,* 2008).

In a study performed in Brazil on HIV-infected people that had been using HAART with protease inhibitors (PIs) for at least three years, 45.7% presented with central obesity (associated with a greater consumption of fats) (Jaime *et al.,* 2006). For every increase of ten grams (g) of fat intake per day the odds of developing central obesity increased 1.28 times. The results suggest that the amount of carbohydrates and lipids in the diet, regardless of total energy intake, may modify the chances of developing central obesity in the studied population (Jaime *et al.,* 2006). However, Hendricks *et al.* (2006) further suggest that the overall quality of dietary intake may have future implications regarding cardiovascular disease, metabolic syndrome, and other health risks associated with overweight and obesity. In the era of ART, it is no longer supported that the constantly gaining body weight is a protective buffer against HIV-related wasting and progression to HIV (Dong and Imai, 2012:878). Weight reduction in obese HIV-infected patients on ART is crucial, as even modest reductions in body weight improve hypertension and impaired glucose metabolism (Bergersen, 2006).

Health systems in poorer countries increasingly have to cope with the double burden of treating expensive diet-related noncommunicable diseases (such as diabetes mellitus and hypertension) while simultaneously attempting to combat undernutrition and other common communicable diseases (such as diarrhoea and TB) (ASSAf, 2007:19). Physical activity, aerobic exercise, and resistance training

to work together with optimal nutrition intake are recommended to achieve a healthy weight and maintain lean body mass (Dong and Imai, 2012:878).

ii) Fat redistribution syndrome

In 1998, two years after the broad introduction of ART, Carr *et al.* (1998) described a syndrome of body fat changes, increased visceral fat, increased triglycerides, increased total cholesterol and insulin resistance. HIV-associated lipodystrophy syndrome refers to the metabolic abnormalities and body shape changes seen in patients with HIV (Dong and Imai, 2012:878).

The loss of body fat that occurs with lipodystrophy is not the same as the weight loss that happens with wasting. According to Dong and Imai (2012:876), the typical body shape changes include fat deposition (commonly visceral adipose tissue in the abdominal area or as a dorsocervial fat pad and breast hypertrophy) and peripheral fat atrophy (loss of subcutaneous fat in the limbs, hands, feet, face and buttocks). Metabolic alterations and changes in body composition are increasingly apparent in patients receiving HAART for HIV-infection (Carr, 2008) and peripheral lipoatrophy (loss of body fat) is a general finding among HIV-infected men and women with metabolic abnormalities (Joy *et al.,* 2008).

The cause of HIV-associated lipodystrophy syndrome is multifactorial and is influenced by duration of HIV-infection, duration of taking ART medications, age, gender, race and ethnicity, increased viral load, and increased body mass index (BMI) (Dong and Imai, 2012:878).

iii) Noncommunicable disease

Noncommunicable diseases are the leading causes of death globally, killing more people each year than all other causes combined (WHO, 2010b). The presence of comorbidities such as heart disease, diabetes mellitus, hepatitis, and opportunistic infections may complicate the profile of the HIV-infected patient on ART (Dong and Imai, 2012:873). Chronic lifestyle diseases share similar risk factors, including tobacco smoking, diabetes mellitus hypertension, obesity, hyperlipidemia and physical inactivity (Van Zyl *et al.*, 2012). Hyperlipidemia is characterised by high triglycerides and low-

density lipoprotein (LDL)-cholesterol and low high-density lipoprotein (HDL)-cholesterol together with insulin resistance. It has been estimated that heart disease and type 2 diabetes mellitus are 80-90% preventable by changing one's lifestyle to include an appropriate diet, a healthy body weight and regular exercise (Rolfes *et al.,* 2006:625).

Since the late 1990s, various reports have described insulin and carbohydrate metabolism abnormalities in HIV-patients receiving HAART (Salomon *et al.,* 2002; Salas-Salvadó and García-Lorda, 2001). Metabolic changes may include increased resistance to insulin and abnormally high levels of blood cholesterol and triglycerides (Kressy *et al.,* 2008; Woods *et al.,* 2008). Insulin resistance in HIV-infected patients does not seem to represent a significant independent risk factor for the development of cardiovascular disease; but, the association with other metabolic complications (dyslipidaemia, fat redistribution) and cardiometabolic syndrome may increase the risk of type 2 diabetes mellitus and cardiovascular disease (Bevilacqua *et al.,* 2009). It has been shown that HIV-infected persons may be at a greater risk for developing type 2 diabetes mellitus, because of viral co-infection and adverse effects of treatment (Ledergerber *et al.,* 2007). Furthermore, several studies have reported increases in the incidence of hyperglycemia and hyperinsulinemia, and other features including insulin resistance and impaired glucose tolerance. Insulin resistance is seen frequently in patients receiving ART and forms part of the lipodystrophy syndrome (Paton *et al.,* 2005a).

Cardiovascular disease is one of the most common causes of death in HIV-infected adults on HAART (Bader and Kelly, 2008). However, studies show that unless HIV-infected people with high blood lipids have other risk factors that increase heart disease, such as smoking, obesity, or high blood pressure, their chances of heart attack are no greater than that of HIV-uninfected people (Kressy *et al.,* 2008).

iv) Bone mineral loss

Many factors may contribute to decreased bone mineral density in HIV-infected patients (Rivas *et al.*, 2008). These may include physical inactivity; low body weight; decreased intake of calcium and vitamin D; cigarette smoking; alcohol use; and low sex hormone levels (Rivas *et al.*, 2008).

Osteopenia, osteoporosis, and osteonecrosis are the most significant bone disorders affecting patients with HIV-infection (Glesby, 2003). Osteonecrosis has been reported in HIV-infected patients since 1990, and its incidence appears to be increasing (Glesby, 2003). Changes in bone metabolism may occur in patients with HIV that are not on HAART, as well as those receiving treatment. Osteopenia is frequent in treatment-naïve HIV-infected men with AIDS (Rivas *et al.*, 2008). This means that HIV itself may be a contributing factor, mediated by immune activation and cytokines (Glesby, 2003).

HIV-infected patients receiving HAART have a high prevalence of reduced bone mineral density, but patients not receiving ART also have a higher than expected prevalence of reduced bone mineral density (Glesby, 2003). Rivas *et al.* (2008) found that HIV-infected individuals with AIDS receiving HAART have significant bone demineralisation after one year on treatment and this includes osteopenia and osteoporosis in patients receiving PIs (Rivas *et al.*, 2008). Bone mineral density loss seems to be higher on a lopinavir/ritonavir (LPV/r)-based regimen than with three NNRTIs treatment at some locations, including the lumbar spine and/or at the femoral neck (Rivas *et al.*, 2008).

2.5 SOCIO-DEMOGRAPHIC STATUS AND HOUSEHOLDS FOOD SECURITY

The prevalence of HIV-infection and AIDS has increased steadily in all demographic groups, yet the epidemiologic data indicate that lower-income populations are severely affected by HIV (Kim *et al.,* 2001). Poverty is a basic cause of undernutrition, because it is associated with unemployment, inability to pay for food, healthcare and basic services, disintegration of family life, inability to care for children, vulnerability, homelessness and despair (ASSAf, 2007:25-16). Although South Africa is considered to be a middle-income country, it also has one of the highest levels of income inequality (Majumdar and Mazaleni, 2010).

As mentioned earlier, urbanisation, modernisation, acculturation or westernisation of black South Africans is characterised by changing dietary intakes that increase the risk of overweight and obesity

together with micronutrient undernutrition (ASSAf, 2007:26). In all population groups, increased exposure to cheaper energy-dense, high-fat and sweet foods, are leading to food choices that contribute to overnutrition in respect of macronutrients, and undernutrition in respect of micronutrients in many individuals (Majumdar and Mazaleni, 2010). Benefits of urbanisation, such as lowering of infant mortality rates and longer life expectancies have been reported, as well as improved socio-economic conditions and the wider availability of foods. However, an increase in the incidence of noncommunicable diseases has been documented. In many developing countries in advanced stages of nutrition transition, the burden of coronary artery disease has shifted from the rich to the poor (Vorster *et al.,* 2007). The Transition in Health during Urbanisation of South Africans (THUSA) study was undertaken to compare the prevalence of known risk factors for noncommunicable diseases in the North West province at different stages of urbanisation. In findings of the THUSA study, it is mainly the African population that is experiencing rapid urbanisation and the nutrition transition (Vorster *et al.,* 2007). The concept of the nutrition transition is described by Popkin (1994) as "a sequence of characteristic dietary and nutritional problems resulting from large shifts in overall dietary structure, related to changing economic, social, demographic and health factors". Despite the increasing contribution of HIV to the development of undernutrition, traditional risk factors such as poor nutrition, parental disadvantage and illness, poverty, and social inequity remain important contributors to the prevalence of severe malnutrition (Saloojee *et al.,* 2007).

The study undertaken by Majumdar and Mazaleni (2010) in the rural Eastern Cape found that participants living with HIV/AIDS reported sadness and worry as a result of their health problems and the fate of their children. The study aimed to explore and describe the challenges faced by people living with HIV/AIDS, as well as their caregivers in two remote South African villages. Their ability to cope with the illness given the limited social and economic resources within their communities was also evaluated. People living with HIV/AIDS reported worsening in physical health due to their illness. Most suffered from lack of appetite, tiredness and pain (Majumdar and Mazeleni, 2010). In addition, poverty also increases migrant labour, family break-up, landlessness, overcrowding and homelessness. These factors can increase the tendency of having multiple sexual partners (FAO, 2003). Stigma and isolation were important issues for the participants living with HIV/AIDS and their

direct informal caregivers. According to UNAIDS (2008), civil society reports from over thirty countries indicate that the stigma and discrimination against people living with HIV remains strong. The participants from these countries lived in a small rural community and found it difficult to hide their HIV status, particularly as their disease progressed. According to Majumdar and Mazaleni (2010), HIV-infected participants living in South Africa attributed to the extreme poverty affecting the community to the high level of unemployment, as well as other economic problems existing in South Africa. All participants were unemployed and living in extreme poverty. Due to the financial implications and limited physical mobility created by HIV/AIDS, access to basic material needs (food, medications and hygiene products) can be a significant challenge for people living with HIV/AIDS (Majumdar and Mazaleni, 2010).

The standard of housing, occupational density, access to clean safe water and sanitation, as well as the shortage of the availability of adequate cooking and refrigeration facilities may all contribute to an increased risk of malnutrition (ASSAf, 2007:27). Much has been done during the past years to improve housing conditions in South Africa. Many South Africans in transition, however, still live in informal settlements in conditions that do not assure optimal nutrition (MacIntyre *et al.*, 2002). The 2003 South African Demographic and Health Survey (SADHS) is the second national health survey to be conducted by the DoH, following the first in 1998. This survey found that the average number of persons per household was 3.8, compared to 4.2 persons in the 1998 SADHS (DoH, 2004). The modal household size in non-urban areas was four persons per household, compared to an urban mode of two persons per household. In non-urban households, the average household size was four persons, noticeably smaller than 4.7 persons found in the 1998 SADHS. This decline between the two SADHS surveys is probably related to the increase in the number of houses that have been built between the two surveys (DoH, 2004). The South African Census of 2011 showed a steady increase in the percentage of households living in formal dwellings over time; the percentage of households living in traditional dwellings has almost halved while the percentage of households living in informal dwellings has decreased from 16.2% in 1996 to 13.6% in 2011 (Stats SA, 2012).

Poverty and the related poor nutritional status may also increase the risk of HIV-transmission from mother to child (Piwoz and Preble, 2000). Women of reproductive age, their infants and young children are among the most vulnerable for malnutrition and progression of HIV/AIDS and mortality is increased in the malnourished, as seen in Eastern and Southern Africa (Ernst, 2007). Based on studies of HIV-infected children in South Africa, more than 50% were underweight and stunted, while more than 60% presented with multiple micronutrient deficiencies (Hendricks *et al.,* 2007). A study conducted by Saloojee *et al.* (2007) identified risk factors for severe childhood malnutrition in a rural South African district with a high HIV/AIDS-prevalence. Despite the increasing contribution of HIV to the development of severe malnutrition, traditional risk factors such as household composition, household food security, poor nutrition and health status were found to be important contributors to poor nutritional status. A study undertaken by Majumdar and Mazaleni (2010) in the rural Eastern Cape found that poverty also increases migrant labour, family break-up, landlessness, overcrowding and homelessness. South Africa is the only country in the sub-Saharan Africa region that offers state pension and social grants to its citizens (Ladzani, 2009), but the state pension is inadequate to meet the needs of an average family as the cost of living is high.

Most-at-risk populations are defined as those populations that are found to have a higher than average HIV-prevalence when compared to the general population (Shisana *et al.*, 2009). According to USAID (2006), most-at-risk populations engage in behaviours that put them at higher risk for HIV - infection. AIDS-related mortality alters demographic household structure, and can frequently result in increased female- and child-headed households and an increased household dependency ratio (USAID, 2006). As stated by the SADHS (2003:13), one of the possible reasons for more households taking care of another's child, could relate to the practice among some mothers of sending their children to the children's grandmother for care to enable the mothers to engage in the formal labour market. It may also relate to the increased numbers of deaths of young men and women over the past few years. This is confirmed by the finding that of those children living with neither parent, 0.8% in 1998 versus (vs.) 2.4% in 2003 had lost both parents to death (SADHS, 2003:13).

The SADHS 2003 showed that people who lived in urban areas had about three times the level of achieved tertiary qualifications compared to those living in non-urban areas (SADHS, 2003:15). This may be a reflection of residential differences related to access to tertiary institutions, affordability, post-study employment opportunities, and possibly also reflects the higher proportions of older persons living in non-urban areas, as well as the fact that older persons have considerably lower levels of education. The lack of education or low educational level of most citizens in South Africa and neighbouring states in Southern Africa is associated with low or no income and limited purchasing power for the affected individuals (Sibanda *et al.* 2007). Evidence from Uganda showed that a child who drops out of school is three times more likely to become HIV-infected in his or her twenties than a child who completes their basic education (UNAIDS, 2008). Furthermore, a study performed in the Bushbuckridge District (Limpopo province) in South Africa found that most (63%) households earned less than R1,000 (≈US$150) per month, well below the poverty line (defined in 2001 as an income of R1,541 per month for a household of five) (Saloojee *et al.*, 2007; HSRC, 2004).

For the first time in the 2003 SADHS survey a question was asked which examined acceptance of people living with HIV/AIDS in a number of particularly sensitive areas (SADHS, 2003:91). Since the number of people living with HIV/AIDS has increased, there is a need to understand how strong the stigma of the infection and disease is in the population. When a person accepts his or her situation it may indicate better knowledge and understanding of HIV/AIDS (SADHS, 2003:91). The majority of women (85%) reported that they would be willing to care for a family member with HIV/AIDS at home. Women were asked if they would be prepared to buy fresh vegetables from a vendor they knew to be infected with HIV and overall almost three-quarters (73%) said yes. Most women (82%) believed an HIV-infected teacher should be able to continue teaching. The lowest level of accepting attitudes was in the disclosure of the HIV status of a family member. However, nearly two-thirds of women (60%) indicated that they would not necessarily want an HIV-infected family member's HIV status to remain a secret (SADHS, 2003:91). In a study undertaken by Brown *et al.* (2010) in two communities in Cape Town, South Africa, blacks were more likely than coloureds to report experiencing stigma in their families. Both blacks and coloureds felt the family should be the most important focus of interventions for eliminating HIV-related stigma (Brown *et al.*, 2010). Within the

context of the family, race, cultural values, and religious and spiritual values all contribute to HIV-stigma (Brown *et al.,* 2010).

In a study by Kim *et al.* (2001), in the greater Boston and Providence area amongst HIV-infected adults, about 25% reported a lack of assistance with food shopping and a similar proportion reported lack of assistance with food preparation. The results of this study suggest that in HIV-disease, dietary intake is a complex socio-behavioral phenomenon that reflects the influence of socio-demographic and lifestyle factors (Kim *et al.*, 2001). Due to the physical limitations placed on people living with HIV/AIDS by the illness, performing the tasks of day-to-day living could present a challenge and therefore informal caregivers need to provide assistance for people living with HIV in activities of daily life, such as maintaining hygiene, eating and getting dressed. The level of care required by people living with HIV/AIDS can, in fact, be overwhelming (Majumdar and Mazaleni, 2010).

The nature and extent of the HIV-pandemic's influence on food security have not been fully explored (Sibanda *et al.*, 2007). Although significant progress has been made in recent years in some areas of nutrition, 790 million people in the developing world and 34 million in developed countries are still undernourished and do not have enough to eat (FAO, 1999). According to the United States Department of Agriculture (USDA) (2006a), food security is defined as "access by all people at all times to enough food for an active, healthy live". Households experience food insecurity in the most basic sense when their resources are inadequate simply to obtain "enough food" in order to meet basic needs; the condition that in its severe form, results in hunger for household members (Keenan *et al.,* 2001). Although South Africa is food secure on a national basis, and even in a position to export food, many households experience hunger and food and nutrition insecurity because of all the factors contributing to poverty and underdevelopment (ASSAf, 2007:26). Charlton and Rose (2002) reported household food security in 43% of households in South Africa and it is also suggested that more than 14 million South Africans (35% of the population) are estimated to be vulnerable to food insecurity (HSRC, 2004).

A vicious cycle emerges in that poverty promotes the spread of HIV/AIDS; and conversely, HIV/AIDS contributes to poverty that continues to exist (Lange and Van Der Waals, 2002). The HSRC report of 2004 stated that all dimensions of food security, namely availability, stability, access to and use of food are affected when the prevalence of HIV is high (Ladzani, 2009). One of the effects of HIV-infection is a person's frequent inability to go to work, thus reducing household income (Sibanda *et al.*, 2007). This inability to go to work often results in the HIV-infected person's inability or limited ability to provide for the household due to the progressive nature of the disease (Ladzani, 2009). According to the FAO (2003), access to adequate food is threatened for all family members in affected households. When a family member dies, the incidence of stunting (low height for age) increases among orphans, and the food consumption of all surviving household members often declines, resulting in malnutrition (FAO, 2003). Households affected by HIV/AIDS, in particular those headed by women, find it increasingly difficult to meet their food security needs (FAO, 2003). Furthermore, homelessness is a growing problem, worsened by higher rates of HIV-infection (Fenton and Silverman, 2008:994). The HIV/AIDS-pandemic is often associated with children becoming heads of households and main "breadwinners", which also contributes to food insecurity. AIDS affects agricultural systems and affects the nutritional situation and food security of rural families (FAO, 2003; Ladzani, 2009). As adults become ill and die, families face declining productivity as well as loss of knowledge about farming methods and loss of assets (FAO, 2003). Furthermore, fostering AIDS orphans or hosting and caring for sick relatives, reduces the amount of food available for each household member.

There is an association between low income, food insecurity and nutrient inadequacies (Kirkpatrick and Tarasuk, 2008). Lack of access to adequate, affordable, safe and nutritious food is a major determinant of malnutrition (FAO, 2003) and food security has been associated with the consumption of poor quality diets, lower nutrient intakes, and the consumption of smaller servings of milk products, fruit and vegetables (Kirkpatrick and Tarasuk, 2008). Repetitive diets, based mainly on starches e.g. maize, bread, have also been closely associated with food insecurity (Kennedy, 2009). Dietary compromise and a compromised nutritional status are therefore outcomes of food insecurity (Ladzani, 2009).

Environmental factors are important determinants associated with household food security. However, improving the environment is not necessarily going to lead to better household food security if people do not have access to food (Labadarios *et al.,* 2011). Nutrition security of individuals and households are influenced by various factors, specifically those related to the immediate environment. As stated by Labadarios *et al.* (2011), South Africa should strive for all households to have access to food, water, sanitation and healthcare. This can only happen if economic growth takes place and employment opportunities improve (Labadarios *et al.,* 2011).

2.6 NUTRITION, IMMUNITY AND MALNUTRITION IN HIV/AIDS

Nutrition is recognised as being essential for the production of energy to fulfill the needs of the body, for the provision of building blocks for growth, replacement and repair of cells and tissues, as well as providing micronutrients (ASSAf, 2007:4). Nutritional status, in turn, plays an important role in maintaining a healthy immune system and delaying the progression of HIV to AIDS (Dong and Imai, 2012:864). Even in populations not infected with HIV, poor nutritional status is known to impair immune response (Paton *et al.,* 2005b).

Although the relationship between nutrition and immune function is well established, nutritional intake is often a neglected factor in the progression of HIV-disease (Kim *et al.,* 2001). Failure to receive adequate nutrition during early life may have permanent negative consequences for immune function in adult life (ASSAf, 2007:4). In people infected with HIV, weight loss and loss of body cell mass are strong indicators of poor prognosis (ASSAf, 2007:68). Acute weight-loss episodes are often associated with secondary infections, whereas chronic weight loss in HIV-infection is normally associated with gastrointestinal inflammation and/or infection, as well as associated malabsorption (ASSAf, 2007:68). Weight loss and malnutrition are common in patients with HIV-infection or AIDS (Vorster *et al.*, 2004) and are likely to accelerate disease progression, increase morbidity and reduce survival because of the well documented impact of malnutrition on immunity (Tomkins, 2002). Nutritional problems have been shown to be significant and contribute to health and death in

HIV/AIDS patients (Suttajit, 2007). Along with the etiological factors of HIV and decreased immunity, there are a number of other risk factors including opportunistic infections, malnutrition, wasting syndrome, and oxidative stress (Suttajit, 2007). Poor nutritional status may be worsened by different factors such as inadequate nutrient intake or absorption, metabolic alterations, hypermetabolism, or combinations of these (Stambullian *et al.,* 2007). Other factors may also include alteration of the gastrointestinal tract and drug-nutrient interactions. The symptoms associated with malnutrition in people living with HIV/AIDS include weight loss, loss of muscle tissue and subcutaneous fat, vitamin and mineral deficiencies, reduced immune function, and greater susceptibility to infection (Piwoz and Preble, 2000).

HIV-infection increases nutritional requirements by 10% in the case of asymptomatic HIV-infection and 20-30% in the case of symptomatic HIV-infection or AIDS (UNAIDS, 2006). After an opportunistic infection, nutritional requirements increase by twenty to 50% in both adults and children (WHO, 2005a). Factors such as altered metabolism, nutrient deficiencies, severity of disease, comorbidities, and opportunistic infections should be taken into account when evaluating energy needs (Dong and Imai, 2012:877). Calculating energy and protein needs for this population is difficult because of other issues such as wasting, obesity and HIV-associated lipodystrophy syndrome (Dong and Imai, 2012:877-878).

Nutrients affect immune system function directly via processes like protein synthesis or indirectly via their roles in various enzymes (FAO, 2003). The most common forms of malnutrition include micronutrient malnutrition and protein energy malnutrition (PEM) (ASSAf, 2007:15). PEM refers to inadequate availability or absorption of energy and proteins in the body. Immune changes associated with AIDS are similar to those seen in PEM (Fenton and Silverman, 2008:1009). When energy, macro-(carbohydrate, protein and fat) and micronutrient intake is insufficient to meet metabolic needs, PEM and deficiencies of micronutrients develop (Fenton and Silverman, 2008:1009). Deficiency of protein stores and abnormal metabolism occur in HIV/AIDS, but no evidence exists for increased protein intake over and above that necessary to accompany the required increase in energy (WHO, 2005b).

However, with an opportunistic infection, an additional 10% increase in protein intake is recommended because of increased protein turnover (WHO, 2005b).

Micronutrient deficiencies are common in people with HIV-infection as a result of malabsorption, drug-nutrient interactions, altered metabolism, gut infection, and altered gut barrier function (Dong and Imai, 2012:878). These deficiencies can affect immune function and contribute to disease progression (Dong and Imai, 2012:878; FAO, 2003). Serum levels of vitamin A, zinc, and selenium are often low during times of response to infection (Coyne-Meyers and Trombley, 2004). Low levels of vitamins A, B12, and zinc are associated with faster disease progression (Coyne-Meyers and Trombley, 2004). Higher intakes of vitamins C and B have been associated with increased CD4 counts and slower disease progression to AIDS (Coyne-Meyers and Trombley, 2004).

Malnutrition independently worsens immune dysfunction, can impair organ function, compromise the effectiveness of medication and affect quality of life (FAO, 2003). Malnutrition and HIV/AIDS can form a vicious cycle whereby malnutrition increases the susceptibility to infections and thus has a negative impact on the severity of the HIV/AIDS-disease. This will, in turn, contribute to a further deterioration of nutritional status (FAO, 2003). The overall effect of undernutrition is deterioration of immune function and clinical status that can contribute directly to morbidity and mortality.

2.6.1 Wasting in HIV/AIDS-infection

Wasting implies unintentional weight loss and loss of lean body mass, which have been strongly associated with an increased risk of disease progression and mortality (Dong and Imai, 2012:878). Wasting syndrome is defined by a body weight loss of more than 10% of the usual body weight and is associated with chronic diarrhoea and/or fever and/or asthenia with a lack of other detectable causes of wasting other than the HIV-infection itself (Salomon *et al.,* 2002). Before widespread use of ART, AIDS wasting syndrome was the second most commonly reported AIDS-related condition for adults in the Unites States of America (Fenton and Silverman, 2004:1044) and the wasting syndrome and other forms of malnutrition were identified as one of the first line complications of the disease (Salomon *et al.*, 2002).

HIV-related undernutrition is different from simple starvation (Salomon *et al.,* 2002). Starvation results in predominant loss of body fat and to a lesser degree of lean body mass. The malnutrition associated with HIV-infection and AIDS has characteristics similar to other infection processes and some that are unique to HIV (Fenton and Silverman, 2008:1008). Nutrition status is a major factor in survival, and, in the absence of disease, starvation usually leads to death when the victim reaches two thirds of ideal body weight for height. People with HIV/AIDS tend to lose body cell mass with less loss of fat, in contrast to uncomplicated starvation in which fat stores are depleted.

Weight loss must be viewed as the result of an imbalance between energy input and energy output; therefore hypermetabolism and the resultant increase in energy expenditure, is considered to be a significant factor in the etiology of wasting associated with HIV-infection (Salas-Salvadó and García-Lorda, 2001). Wasting may be caused by a combination of factors including inadequate dietary intake, malabsorption, and increased metabolic rates from viral replication or complications from the disease (WHO, 2005b; Grinspoon and Mulligan, 2003). In men, the weight loss predominantly reflects the loss of lean body mass, which has been shown to be a strong predictor of survival, independent of CD4 count (Friis *et al.,* 2002). Women tend to lose both lean and fat body mass. Wasting, particularly loss of metabolically active lean tissue has been associated with increased mortality, accelerated disease progression, loss of muscle protein mass and impairment of strength and functional status (Grinspoon and Mulligan, 2003). Thus, a relationship has been established between survival and the extent of the body cell mass depletion (Salas-Salvadó and García-Lorda, 2001).

In people infected with HIV, weight loss and loss of body cell mass are strong predictors of poor prognosis (ASSAf, 2007:141). Wasting may increase morbidity by prolonging recovery from opportunistic infections, therefore lengthening hospital stay, and further impairing resistance to non-fatal infections such as oral candidiasis (Paton *et al.,* 2005b). Instances of chronic weight loss in HIV-infection are normally associated with gastrointestinal inflammation and/or infection and associated malabsorption (ASSAf, 2007:132). These features are associated with increased resting energy expenditure, accelerated protein turnover, decreased energy intake, diarrhoea and malabsorption and in most cases acute weight loss is associated with secondary infections (ASSAf, 2007:132). Apart

from the effects on survival, loss of lean tissue has been shown to significantly affect physical functions in patients with HIV-infection (Paton and Yau-Ming, 2006). In a study performed in Singapore by Paton *et al.* (2005b), involuntary weight loss of more than 10% of initial body weight or a sustained loss of more than 5% of body weight within the previous six months was used as a definition of HIV-wasting syndrome (Paton *et al.,* 2005b).

Studies have indicated that HIV-wasting syndrome is also associated with decreased serum concentrations of vitamin A, folate and carotene (Kim *et al.,* 2001). Severe weight loss can result in organ damage, which may increase the risk of death from infections (Fenton and Silverman, 2008:1009). Involuntary weight loss can cause profound psychological stress to the patient and is often mentioned as one of the most upsetting features of the illness.

2.6.2 Factors that contribute to malnutrition in HIV/AIDS

Interactions between pre-existing malnutrition and HIV are not yet well understood, though it is known that malnutrition impairs immune function at individual level (USAID, 2006). The development of malnutrition is multifactorial and HIV-infection can lead to nutritional deficiency through decreased food intake, malabsorption, and increased utilisation and excretion of nutrients (Kotler, 2000; Ernst, 2007; Fenton and Silverman, 2008:1008). Nutrition alterations in HIV-infection include increased energy expenditure, nutrient malabsorption, micronutrient malnutrition and increased production of inflammatory cytokines with lipolytic and proteolytic activity (Van Lettow *et al.,* 2003). A number of micronutrient deficiencies have been described in individuals with HIV-infections (Van Lettow *et al.,* 2003) and may be caused by poor quality diets, characterised by high intakes of starchy but low consumption of animal and fish products, fruits, legumes, and vegetables (ASSAf, 2007:15). Other key factors that contribute to malnutrition in patients with HIV/AIDS include depletion of antioxidant nutrients/oxidative stress and food-drug interactions [USAID/World Food Programme (WFP)/WHO, 2008]. Therefore, malnutrition and weight loss are likely to accelerate disease progression, increase morbidity and reduce survival (WHO, 2005b). Poor nutritional status may also weaken adherence and response to ART and worsen socio-economic impact of the virus (USAID/WFP/WHO, 2008).

In the following section factors that contribute to malnutrition in HIV/AIDS, including insufficient nutrient intake and increased requirements; increased nutrient losses; metabolic alterations associated with HIV-infection; depletion of antioxidant nutrients/oxidative stress and food-drug interactions, will be reviewed.

2.6.2.1 Insufficient nutrient intake and increased requirements

Overall anorexia leading to a reduced nutrient intake is the most important cause of weight loss in HIV-infected patients (Macallan *et al.*, 1995; WHO, 2005b). Reduction in dietary intake leads to growth failure in HIV-infected children and wasting in HIV-infected adults (FAO, 2003). As previously mentioned, poor dietary intake occurs in a background of poverty and lack of food in the household (WHO, 2005b).

Certain clinical symptoms of HIV-disease may interfere with adequate food consumption (Kim *et al.,* 2001) and it has been shown that infections significantly contribute to the development of nutritional deficiencies (FAO, 2003). Pneumocystis pneumonia, Kaposi's sarcoma, candidiasis, and herpes in the oropharyngeal or esophageal area can inhibit normal chewing and swallowing, thus limiting nutritional intake (Dong and Imai, 2012:876). Pneumocystis pneumonia causes difficulty in chewing and swallowing due to shortness of breath (Dong and Imai, 2012:876). Decreased food intake can also result from anorexia secondary to TB-infection, medications, depression, infection, symptoms such as diarrhoea, dyspnea or fatigue, or neurologic disorders (Dong and Imai, 2012:876). Anorexia may also be caused by certain ART and improve as patients with HIV/AIDS start to improve clinically once they become established on ART (WHO, 2005b). Furthermore, the presence of opportunistic infections increases the need for nutrients (both macro and micronutrients), and may lead to inefficient utilisation and loss of nutrients (FAO, 2003).

The staple diet of the majority of HIV-infected people in the Free State province is maize, and a large number of them are from lower socio-economic groups (Dannhauser *et al.,* 1999). Although maize meal and bread are enriched with certain vitamins and minerals, the adequacy of this in patients with increased nutritional needs is unsure. A significant number of HIV/AIDS patients in the Free State

population are, therefore, possibly at risk for malnutrition, which may contribute to disease progression (Dannhauser *et al.,* 1999). A study undertaken in Boston reported that energy intake per kilogram (kg) decreased by BMI category for both men and women that were infected with HIV, with mean total fat and saturated fat intakes above recommendations for both men and women (Hendricks *et al.,* 2006). Total grams dietary fiber decreased as BMI increased and individuals in all BMI groups had micronutrient intakes below the Dietary Reference Intakes (DRIs). Dannhauser *et al.* (1999) found that the majority of patients in their study undertaken in the Free State amongst HIV-infected hospital patients, reported energy and protein intakes that met at least 67% of the Recommended Daily Allowance (RDA), but had insufficient intakes of micronutrients.

2.6.2.2 Increased nutrient losses

During weight loss in HIV/AIDS the proportion of body stores that are lost, whether it is protein, fat or carbohydrate, depends on the underlying nutritional state and the dietary intake (WHO, 2005b). It is well established that malabsorption is a frequent feature in HIV-infection and that in the presence of malabsorption patients show an appropriate metabolic response via compensatory decrease in resting energy expenditure (Salas-Salvadó and García-Lorda, 2001). Malabsorption, often suspected in the event of loose stools, diarrhoea, or vomiting, can be caused by some medication, HIV-infection, opportunistic infections such as cytomegalovirus or cryptosporidiosis, or a developed intolerance to lactose, fat, or even gluten (Fenton and Silverman, 2008:1008).

As noted by die World Bank (2007) diarrhoea is defined as “uncontrolled, loose stools, characterised by frequent bowel movements related to diet, infection, medication, and irritation or inflammation of the intestine”. Severe or prolonged diarrhoea can lead to weight loss and malnutrition and the excessive loss of fluid that may occur with AIDS-related diarrhoea can be life-threatening (World Bank, 2007). Diarrhoea is often a common complaint in patients with HIV-infection (Beatty, 2010), and the severity of symptoms ranges from mild, self-limiting diarrhoea to debilitating disease that can result in malnutrition, volume loss, and shock. There are many possible causes of diarrhoea in persons who have AIDS and almost 50% of patients with HIV/AIDS suffer from diarrhoea at some stage during the clinical course of the disease (Fenton and Silverman, 2008:1006). Up to 40% of patients with HIV-

infection report at least one episode of diarrhoea in a given month, and approximately one quarter of patients experience chronic diarrhoea at some point (Beatty, 2010).

A study performed by Rajagopalan *et al.* (2009) showed that chronic diarrhoea was not only associated with frequent hospitalisation, but also a higher risk of mortality. This study demonstrated the importance of being able to diagnose and effectively treat diarrhoea in order to decrease morbidity and mortality among people living with HIV/AIDS. Other bacteria and parasites that cause diarrhoea symptoms in otherwise healthy people may cause more severe, prolonged, or recurrent diarrhoea in persons with HIV/AIDS (World Bank, 2007). Chronic diarrhoea may persist in the absence of identifiable enteric pathogens as a result of what is known as AIDS enteropathy. HIV-induced enteropathy is an idiopathic, direct or indirect effect of HIV on enteric mucosa (Dong and Imai, 2012:876). This can lead to chronic diarrhoea, weight loss, malabsorption, as well as changes in awareness and behaviour (Dong and Imai, 2012:876). Increased levels of inflammation, immune activation, and decreased levels of mucosal repair and regeneration contribute to enteropathy (Dandekar, 2007). Persons with the greatest risk of developing diarrhoea are those with a CD4 cell count of less than 200 to 250 cells/mm^3 (Fenton and Silverman, 2008:1014). Persons with HIV-enteropathy may have villous atrophy and abnormal results on tests of small bowel function. Patients with high stool frequency may also consciously or unconsciously restrict their nutrient intake in the fear of increased stool frequency (FAO, 2003). Malabsorption and diarrhoea are the most prominent and difficult nutritional problems to resolve in HIV/AIDS patients (Fenton and Silverman, 2008:1008).

Loss of body protein during HIV/AIDS is caused by poor diet, malabsorption, endogenous intestinal losses and altered metabolism; all of which are more prevalent during opportunistic infection (WHO, 2005b). Malabsorption of fat, monosaccharides, disaccharides, nitrogen, vitamin B12, folate, minerals, and trace elements occurs in patients with intestinal infections of the small bowel (Fenton and Silverman, 2008:1014). When the large bowel is infected, malabsorption of fluids and electrolytes is common. Malabsorption of fat probably reduces the absorption of the fat-soluble vitamins A and E, which both play a central role in maintaining the immune system (Semba and Tang, 1999; USAID,

2001). With high levels of fat malabsorption, a negative energy balance will develop unless there is considerable increase in dietary energy intake (WHO, 2005b).

Gut-associated lymphoid tissue is an important site for early HIV-replication and severe CD4 T-cell depletion (Dandekar, 2007). A definite depletion of activated, as well as memory CD4 T-cells located in the gut-associated lymphoid tissue, has been seen in HIV-infected individuals early after infection (Mehandru *et al.*, 2004). According to Dandekar (2007), "persistent viral replication in gut-associated lymphoid tissue leads to replenishment and maintenance of viral reservoirs". Assessment of the gut mucosal immune system will provide better insights into the efficacy of HAART in immune restoration and suppression of viral reservoirs.

The mucosa also depends on symbiotic flora in an attempt to manage the primary absorptive functions of the respiratory and gastrointestinal tracts. Symbiotic flora help to protect the host partly by competing for nutrients and space with potentially harmful organisms (ASSAf, 2007:8). According to ASSAf (2007:8), these flora are initially ingested in the diet as natural probiotics, which then colonise the mucosa and depend on undigested oligosaccharides (prebiotics), for symbiosis with the human body.

Probiotics or lactic acid bacteria and prebiotics are sometimes given to possibly assist in maintaining integrity of mucosal surfaces, improve antibody responses and increase white blood cell production (Suttajit, 2007). It is because of this that the role of the gut-associated lymphoid tissue and its relation to HIV and its human host are of particular interest (ASSAf, 2007:8). There are two ways of examining gut integrity in HIV-infection in relation to diet and nutrition (ASSAf, 2007:109). The first is that HIV-infection itself, for example through direct viral effects (Kotler, 2005), may result in negative disruptions of normal gut integrity and of the immunosurveillance function of gut-associated lymphoid tissue, leading to gut malfunction (chronic "sterile" and/or infective diarrhoea) and associated malabsorption of food and/or loss of micronutrients (ASSAf, 2007:109). The second is that dietary factors damaging the gut epithelium may lead to increased susceptibility to HIV-infection, specifically through the gut wall portal believed to be used by the virus in neonates (ASSAf, 2007:109).

2.6.2.3 Metabolic alterations associated with HIV-infection

Salas-Salvadó and García-Lorda (2001) refer to the complexity of the metabolic abnormalities associated with HIV/AIDS, as the "metabolic puzzle".

The influence of ART has already been discussed under 2.4.2. The association between HIV-infection and PEM has been acknowledged since the start of the AIDS-pandemic (Duggan and Fawzi, 2001). Lower serum transferrin concentrations correspond with decreased hepatic synthesis of proteins, and these effects may be linked to the acute protein malnutrition (Van Lettow *et al.,* 2003). At the same time, fevers and infection may increase energy and protein needs (Fenton and Silverman, 2008:1008). Inflammation associated either with infection by HIV or by other secondary infections may play a major role in the etiology of this hypermetabolism via metabolic alterations (Salas-Salvadó and García-Lorda, 2001). In fact, as in other inflammatory states, whole body protein turnover measured by stable isotopes has been shown to increase in AIDS patients even in the absence of secondary infection.

Studies reviewed by Gramlich and Mascioli (1995) indicated elevated total protein and normal or reduced serum albumin levels in asymptomatic HIV-infected and AIDS patients. In a South African study of black females living in Mangaung and not on any current treatment for HIV-infection, various laboratory determinations were done (Hattingh *et al.,* 2009). The metabolic status of both HIV-infected (not on HAART) and HIV-uninfected black women were determined, and the observed blood values were compared with normal values. Significantly higher total serum protein levels in asymptomatic HIV-infected and uninfected black South Africans have also been reported (Vorster *et al.,* 2004). It was found that women who were HIV-infected had significantly lower median blood values for total lymphocytes and serum albumin, but significantly higher median concentrations of serum protein than uninfected women (Hattingh *et al.*, 2009). Plasma fibrinogen and serum insulin concentrations were significantly lower in HIV-infected younger (25-34 years) women than in their uninfected counterparts (Hattingh *et al.,* 2009). Fibrinogen is an acute-phase protein involved in blood clotting (Simpson-Haidaris *et al.,* 1998). The acute-phase response is the primary mechanism used by the body to restore homeostasis following infection, and is characterised by increased

concentrations of circulating fibrinogen. In the study performed by Hattingh *et al.* (2009), median plasma fibrinogen concentrations were lower in HIV-infected women than in HIV-uninfected women. This may be ascribed the fact that almost 50% or more of all women were either overweight or obese and BMI was significantly lower in the younger (25-34 years) HIV-infected women. Significantly more of the young HIV-uninfected women than young HIV-infected women had a BMI placing them in the overweight category.

Alterations in lipid metabolism are common in HIV-infection, and have been recognised since before the era of ART (Salas-Salvadó and García-Lorda, 2001) (Table 2.3). Studies reviewed by Salas-Salvodó and Garcia-Lorda (2001) and Gramlich and Mascioli (1995) showed that the metabolism of lipids may change during HIV-infection and AIDS, unrelated to the use of ART. According to Gkrania-Klotsas and Klotsas (2007), lipid abnormalities were initially noted in HIV-infected patients before the advent of HAART. Lipid abnormalities, now often characteristically seen with HIV-infection, include elevated triglycerides and low elevated total cholesterol, and low HDL-levels of total and HDL-cholesterol (Bader and Kelly, 2008). Other features described in the pre-HAART era include increased concentrations of free fatty acids and a decrease in HDL-cholesterol, which occurs early in HIV-infection. Thereafter, a decrease in LDL-cholesterol may occur, as well as a decrease in serum concentrations of total cholesterol (Salas-Salvadó and García-Lorda, 2001). Hattingh *et al.* (2009) found that older (35-44 years) HIV-infected women had significantly lower total serum cholesterol values than older HIV-uninfected women. The THUSA study performed in the North West province in South Africa, found that HDL-cholesterol and total cholesterol, hemoglobin, albumin and triglycerides were significantly lower in infected subjects (Vorster *et al.,* 2004). One of the first and best described abnormalities is an increase in plasma fasting triglyceride concentrations. In particular, this increase occurs at the time of transition to AIDS and is associated with an increase in hepatic lipogenesis despite prior weight loss, increased lipolysis and lipoid disposal, as well as decreased triglyceride clearance. However, it is unlikely that these changes in triglyceride metabolism have a significant causal role in the wasting process (Paton *et al.,* 2005b).

Table 2.3: Recognised lipid laboratory features during HIV-infection (Salas-Salvadó and García-Lorda, 2001)

	HIV+	AIDS	Lipodystrophy syndrome
Triglycerides	↑	↑↑	↑↑↑
Free fatty acids	N	↑	↑↑
Total cholesterol	N	↓	↑↑
HDL cholesterol	↓	↓	N
LDL cholesterol	N	↓	↑↑
VLDL cholesterol	N	↑↑	↑↑
Small dense LDL	N	↑	↑

N = normal

Abnormalities in glucose metabolism have also been documented in HIV-patients (Gkrania-Klotsas and Klotsas, 2007) (Table 2.4). As previously mentioned, HIV-infected subjects generally have normal or lower than normal levels of glucose without insulin resistance (Salas-Salvadó and García-Lorda, 2001). However, abnormalities in glucose metabolism have been reported before treatment with HAART became the standard care for HIV-patients (Salas-Salvadó and Garcia-Lorda, 2001). Furthermore, it has been observed that in patients with advanced HIV, a significant increase in insulin clearance and sensitivity occurs, which shows that the HIV-infection itself does not contribute to insulin resistance (Paton *et al.,* 2005b). As stated by Bader and Kelly (2008), the increased prevalence of insulin resistance, impaired glucose tolerance, and diabetes mellitus is multifactorial in etiology. Studies reviewed by Salas-Salvadó and Garcia-Lorda (2001) showed that glucose levels may be normal or lower than normal, insulin levels may be normal or increased, while insulin sensitivity is increased in patients not receiving HAART.

The epidemiology of the impaired glucose intolerance is currently unknown and many studies have assessed glucose abnormalities by only using fasting and random glucose levels. Insulin resistance in HIV predicts future glucose intolerance and diabetes mellitus (Table 2.4) (Gkrania-Klotsas and Klotsas, 2007).

Table 2.4: Abnormalities in glucose metabolism during HIV-infection (Salas-Salvadó and García-Lorda, 2001)

	HIV-infection	Lipodystrophy syndrome
Glucose levels	N ↓	N ↑↑
Insulin levels	N ↑↑	↑↑
Insulin:Glucose ratio	N ↓	↑↑
C-Peptide levels	N	↑
Insulin sensitivity	↑↑	↓↓
Oral glucose tolerance test	Normal	Altered

N = normal

Hattingh *et al.* (2009) found that the pattern in median serum insulin differed between the two age groups comparing infected and uninfected women. In the younger group (25-34 years) the serum insulin was significantly lower in the infected group, whereas it was elevated in the older (35-44 years) infected group (although not significantly). These results indicate that in HIV-infected individuals not on ART, serum glucose may remain at normal levels.

Vitamin A-status has been examined in different populations infected with HIV and these studies generally show that lower plasma or serum vitamin A-concentrations are found in patients from developing countries compared with those in developed countries (Van Lettow *et al.,* 2003). However, biochemical studies are limited by the fact that low serum vitamin A, zinc, or selenium levels among individuals with infection do not necessarily mean poor status of these nutrients, since low levels may be part of the response to infection (Fawzi, 2003). In HIV-infected adults, low serum levels of 1,25-dihydroxyvitaminD3, the biologically active form of vitamin D, have been described in the presence of normal levels of 25-hydroxy vitamin D (Van Lettow *et al.,* 2003). Malnutrition, concurrent illnesses and increased nutrient losses probably increase zinc requirements in HIV-infection (Siberry *et al.,* 2002).

In the cross-sectional population-based THUSA survey reported by Vorster *et al.* (2004), alterations in the biochemical nutritional status of asymptomatic HIV-infected black people have been documented. The study was performed to compare the relationships between food (nutrient) intakes and biochemical markers of nutritional status of asymptomatic HIV-infected with HIV-uninfected subjects, to gain more information on the appropriate diet for HIV-infected persons at an early stage

of infection. Two hundred and sixteen asymptomatic HIV-infected and 1550 HIV-uninfected men and women volunteers aged 15 years and older were included. Of the biochemical nutritional status variables, HDL-cholesterol and total cholesterol, haemoglobin, albumin and triglycerides were significantly lower in infected subjects. The HIV-infected patients also had higher globulin and liver enzyme levels than uninfected subjects. In infected subjects, serum albumin correlated significantly with serum lipids, serum vitamin A, serum vitamin E, serum iron, total iron-binding capacity and haemoglobin. The significant positive correlations of the liver enzymes with serum lipids, albumin, vitamin A and iron, observed in HIV-uninfected subjects, was not seen in the infected subjects (Vorster *et al.*, 2004).

The results of the study done by Hattingh *et al.* (2009) indicated a possible impact of HIV-infection on serum total protein and serum albumin in people not on ART. For all other parameters no evidence could be found to indicate a major impact of HIV-infection on nutritional parameters. More information is necessary to correlate changes in nutritional parameters to disease status (Hattingh *et al.,* 2009).

2.6.2.4 Depletion of antioxidant nutrients/oxidative stress

Oxidative stress refers to a condition that occurs when there are more reactive oxygen molecules than can be neutralised by available antioxidant defenses (Smolin and Grosvenor, 2003:243). As a result, an imbalance exists in HIV-infected subjects between the oxidant and antioxidant system, with an advantage towards the oxidant system (Suresh *et al.*, 2009). Oxidative stress occurs either because excessive amounts of reactive oxygen molecules are generated or because antioxidant defenses are deficient. Studies consistently demonstrate that serum antioxidant vitamins and minerals decrease while oxidative stress increases during AIDS-progression (Suttajit, 2007), including increased production of inflammatory cytokines with lipolytic and proteolytic activity (Van Lettow *et al.,* 2003).

Oxidative stress induced by the production of reactive oxygen species may play an important role in the stimulation of HIV-replication and the development of immunodeficiency (Suresh *et al.*, 2009). Due to the fact that HIV-infection is marked by chronic oxidative stress, a number of antioxidant

nutrients, including selenium and vitamins C and E, have been researched (Duggan and Fawzi, 2001). According to Marnett (1999), malondialdehyde is a naturally occurring product of lipid peroxidation and prostaglandin biosynthesis that is mutagenic and carcinogenic. Some cohort studies have shown an association between selenium deficiency and progression to AIDS or mortality (Stone *et al.,* 2010). Laboratory experiments have shown that selenium has an inhibitory effect on HIV *in vitro* through antioxidant effects of glutathione peroxidase and other selenoproteins (Stone *et al.*, 2010). Many studies have reported low selenium status in HIV-infected individuals, and serum selenium concentrations tend to decline with disease progression (Stone *et al.*, 2010). With regards to vitamin E, an important lipid soluble antioxidant, the vitamin reacts with lipid peroxyl radicals (Suresh *et al.*, 2009). This process will eventually stop the peroxidation chain reaction and thereby reduce oxidative damage.

2.6.2.5 Food-drug interactions

Some ART medications require attention to dietary intake (Dong and Imai, 2012:868). Interactions between food and drugs can influence the efficacy of the drug or may cause additional or worse adverse effects. For example, grapefruit juice and PIs both compete for the cytochrome P450 enzymes, thus individuals taking PIs who also drink grapefruit juice may have either increased or decreased blood levels of the drug (Dong and Imai, 2012:868). In South Africa, certain foods, including beetroot, onions, garlic and extra virgin olive oil, have been commonly recommended in HIV-infection (Visser and Labadarios, 2004). Another commonly used traditional remedy especially in sub-Saharan Africa is *Hypoxis hemrocallidea*, commonly known as the African potato. Mills *et al.* (2005) evaluated the impact of this botanical supplement and another, *Sutherlandia*, both commonly used for relief of HIV-related symptoms, on metabolism of ART. In these *in vitro* studies, both substances caused significant decreases in cytochrome P450 activity. There were also reductions in the expression of P glycoprotein (an important component of drug transport) (Mills *et al.,* 2005). These authors concluded that these findings indicate the potential for increased drug toxicity, viral resistance, and treatment failure when these botanicals are used in conjunction with ART (Raiten *et al.*, 2005).

Numerous studies have shown a direct interaction between food and herbal and botanical supplements and ART (Raiten *et al.*, 2005). There is, however, no convincing or consistent scientific evidence that any of these foods, single or in combination, positively altered the course of HIV or any other disease (Visser and Labadarios, 2004). St. John's Wort has also received considerable attention recently because of its possible effect on drug efficacy and safety through its induction of the cytochrome P450 system. The relevance of this concern to people living with HIV/AIDS was reinforced by Piscitelli *et al.* (2002).

2.7 HIV/AIDS AND OTHER FACTORS

Other factors that may play a role in HIV/AIDS include lifestyle factors and physical activity.

2.7.1 Lifestyle factors

Several studies in sub-Saharan Africa have suggested strong links between substance use, including alcohol and recreational drugs, as well as risky sexual behaviour such as having multiple sex partners or having unprotected sex (Fisher *et al.,* 2007; Kalichman *et al.,* 2008; Morojele *et al,.* 2006; Parry *et al..* 2009; Roerecke *et al.,* 2008). Alcohol and recreational drugs work through similar mechanisms in which there is an impairment in both judgement and decision-making which leads the users of risky sexual behaviour (Kalichman *et al.*, 2008; Wechsberg *et al.,* 2008). The increase of risky sexual behaviour in turn increases the risk of HIV-infection among those who use substances (Shisana *et al.,* 2009).

2.7.2 Physical activity

A transition in lifestyle patterns, including dietary and physical activity transitions, have resulted in an increased prevalence of noncommunicable diseases such as overweight, obesity, type 2 diabetes mellitus and cardiovascular diseases in the general population (WHO, 2004). In South Africa, noncommunicable diseases accounted for 37% of annual deaths in 2000 (WHO, 2004). In terms of

attributable deaths, physical inactivity ranked 9th compared with other risk factors (Joubert *et al.,* 2007).

Physical activity plays a vital role as preventative measure for overweight and obesity in the lives of young (Kruger *et al.,* 2003) and adult (Cook *et al.,* 2005) individuals, but compared with other regions and the global average, South African adults have a particularly high prevalence of physical inactivity (Joubert *et al.*, 2007). Basic daily functions such as gathering and chopping wood, tending to cattle, fetching water and planting vegetables are, however, more prevalent in rural areas than in the urban setting (Caballero, 2006).

Malnutrition increases fatigue and physical inactivity in HIV-infected persons (Piwoz and Preble, 2000). It is believed that the weakest patients have the lowest total energy requirements (Salas-Salvadó and García-Lorda, 2001). This is because patients' activity levels tend to decline as they become more and more unwell. Although once viewed as a disease that progresses to death, HIV-infection now presents as a disease with an uncertain natural history, and even a chronic manageable disease for some (Nixon *et al.,* 2002). HIV-infected individuals have increased needs that include management of impairments, disabilities and handicaps. Exercise is a key management strategy to address these issues and assist persons living with HIV/AIDS (Nixon *et al.,* 2002).

Dietary interventions alone have shown limited effect in lowering lipid-levels in dyslipidaemic patients receiving ART (Barrios *et al.,* 2002), but a combination of dietary intervention and exercise may reduce total cholesterol, triglyceride levels and insulin resistance (Jones*,* 2001). Exercise or physical activity is increasingly being recommended as a positive addition to the treatment regimen of HIV-infected individuals (Jones*,* 2001). Exercise has been shown to be effective in decreasing hyperlipidemia, central adiposity, and other co-morbidities associated with coronary artery disease in non-HIV-infected populations (Jones, 2001). Exercise may also be used to address unwanted changes in weight and body composition in people living with HIV-infection on HAART (O'Brien *et al.,* 2004).

Exercise has also been used successfully to treat psychological conditions such as depression and anxiety that are common in HIV-infected individuals (Dudgeon *et al.,* 2004). Numerous studies document that stress accelerates disease progress, including HIV (Scott-Sheldon *et al.,* 2008). HIV-infected individuals experience numerous physical and psychosocial life events that can potentially overwhelm their ability to manage their daily lives (Tromble-Hoke *et al.,* 2005). A study performed at the Center for Health and Behavior, Syracuse University in New York in HIV-infected adults, found that men with more severe stress events were more likely to experience undesirable symptoms, such as anxiety, depression, decreased quality of life and hormonal imbalances, that could adversely influence nutritional status (Scott-Sheldon *et al.,* 2008). Compared to controls, stress-management interventions, including exercise, reduced anxiety, depression, distress and fatigue, improved quality of life. Furthermore, stress-management interventions appeared to improve CD4 counts, viral load, or hormonal outcomes compared to controls (Scott-Sheldon *et al.,* 2008). Aerobic exercise has been associated with improvements in strength, cardiovascular function, and psychological status (O'Brien *et al.,* 2004), and hence appears to be safe and beneficial for adults living with HIV.

While resting metabolic rate is often increased in HIV/AIDS, total daily energy expenditure does not necessarily increase because physical activity may be reduced due to the patient feeling too ill to get up and work (Hsu *et al.*, 2005). As with many infections, increased resting metabolic rate is an important factor for energy imbalance in HIV/AIDS (WHO, 2005b). Total daily energy expenditure was found to be decreased among men with HIV/AIDS during rapid weight loss, mainly because physical activity was reduced (Macallan *et al.*, 1995; Sheehan and Macallan, 2000). Several studies have shown the benefits of graded exercise schedules on body composition and well-being, but patients with severe HIV/AIDS associated wasting often present with fatigue and are unlikely to be able to maintain high levels of physical activity (Hsu *et al.*, 2005). However, moderate physical activity needs to be considered more positively as a means of rebuilding muscle protein stores.

2.8 MANAGEMENT STRATEGIES

Although HIV-infection cannot be cured, it can be controlled with specific drugs given at certain stages of the progressive disease (ASSAf, 2007:4). The emphasis in the medical and nutritional management of infected people during the phases prior to drug administration is still on general, non-pharmacological support, especially as for many reasons it is acceptable to postpone the introduction of specific ART for as long as possible (ASSAf, 2007:4).

2.8.1 Medical management

HIV-related morbidity and mortality originates from HIV affecting the immune system (Dong and Imai, 2012:867). If untreated, HIV can replicate at millions of particles per day and rapidly progress through the stages of HIV-disease (Dong and Imai, 2012:867). Early and adequate treatment of infection appears to be the most important way of retaining nutritional status in people living with HIV/AIDS (FAO, 2003).

2.8.1.1 Prophylaxis

Daily prophylaxis with trimethoprim-sulfamethoxazole (TMP-SMZ) significantly decreases morbidity and mortality among people living with HIV (Forna *et al.*, 2006). Existing guidelines recommend that HIV-infected pregnant women receive prophylaxis, but they differ with regards to stage of disease at which to initiate treatment. Due the substantial benefits of TMP-SMZ prophylaxis for HIV-infected women living in resource-limited settings, Forna *et al.* (2006) indicates that it is safe to adhere to the WHO guidelines recommending daily TMP-SMZ prophylaxis for HIV-infected pregnant women (Forna *et al.*, 2006).

2.8.1.2 Antiretroviral therapy

The introduction of three-drug combination ART in 1996 transformed the treatment of patients infected with HIV and has significantly decreased AIDS-defining conditions and mortality (Dong and Imai, 2012:867). The latest adults and adolescents ART guidelines are attached (DoH, 2013).

The fundamental goals of ART are to achieve and maintain viral suppression, reduce HIV-related morbidity and mortality, improve quality of life, and restore and preserve immune function (Dong and Imai, 2012:867). These goals can generally be achieved within 12-24 weeks of initiation if there are no complications with adherence, or resistance to medications (DHHS, 2010). There is strong evidence for the clinical benefits of ART in adults with advanced HIV/AIDS as determined clinically or immunologically (WHO, 2005a). The precise clinical and or immunological criteria for initiating ART is usually outlined in National treatment guidelines (DoH, 2013).

Most drugs are formulated as individual medication, but increasingly many are available as fixed-dose combinations to simplify treatment regimens, decrease amounts of pills, and potentially improve patient medication adherence (Dong and Imai, 2012:867). Currently ART includes more than twenty ARV agents from six mechanistic classes of drugs, namely nucleoside and nucleoside reverse transcriptase inhibitors (NRTIs), NNRTIs, PIs, fusion inhibitors, chemokine receptor 5 (CCR5) antagonists and Integrase Strand Transfer Inhibitors (INSTIs). Recently, a regimen consisting of raltegravir was approved for treatment-naive patients, making the combination of an INSTIs with two NRTIs another option (DHHS, 2010). There are clinical situations when individuals need to replace EFV with NVP, such as during pregnancy. According to the WHO (2010a), the most common scenarios are when patients temporarily change from NVP to EFV because they need to take rifampicin-containing TB-treatment and subsequently switch back to NVP on completion of TB-treatment, and individuals with persistent EFV central nervous system intolerance.

Evidence supports strong recommendations for the correct timing of ART initiation, in order to address the critical outcomes of risk of death, disease progression (including TB), and the occurrence of serious adverse events (WHO, 2010a). Earlier initiation will, however, mean longer exposure to ART (estimated to be one to two years more) and the possibility of more ART-related side-effects.

Treatment access has dramatically expanded (UNAIDS, 2008). From 240,000 people in 2001, 1.3 million people in low- and middle-income countries received ART in 2005, and 21 countries met or exceeded targets to provide treatment to at least 50% of those who needed it (USAID, 2006).

Globally, however, ARV drugs still reached only one in five who need them in 2008 (UNAIDS, 2008). Furthermore, information and health services are less available in rural areas than in cities (FAO, 2003). Rural people are therefore less likely to know how to protect themselves from HIV and, if they fall ill, less likely to get care.

2.8.1.3 HIV-drug resistance

As more people start ART, concerns are growing about the possible increase in HIV-drug resistance (UNAIDS, 2012). HIV mutates rapidly, and since treatment is intended to be lifelong, more drug-resistant strains of the virus seem likely to emerge (UNAIDS, 2012). The rate of acquisition of HIV-drug resistance in people on HIV-treatment has remained relatively stable and low, due to the use of effective HIV-regimens. However, the transmission of HIV-drug resistance among people recently infected with HIV increased from about 1% in 2005 to about 3% in 2010 (UNAIDS, 2012). Among people initiating treatment in low- and middle-income countries, about 5% had drug resistance in recent surveys (UNAIDS, 2012). Emergence of drug resistance is the most common reason for treatment failure (Simon *et al.,* 2006). Transmission of drug-resistant HIV has increased in parts of the developed world (Vella, 2002). Without an adequate blood level of active drugs, HIV mutates rapidly, causing resistance to those drugs. High-level resistance to one medication can result in resistance to others of the same type (Fenton and Silverman, 2008:1001). Resistance of HIV-1 to ARV drugs is one of the main challenges in ART, and, due to the concerns for nucleoside cross-resistance, resistance is of critical interest for planning ART strategies (Picard *et al.,* 2001). Increasingly, people with new HIV-infections have resistance to at least one class of medications (Fenton and Silverman, 2008:1001).

If healthcare workers are not well-informed, patients are not adherent, or regimens are not sufficiently potent, provision of treatment in the developing world could result in a global epidemic of drug-resistant HIV (Vella, 2002). The current global experience with TB emphasises just how real these concerns are. Drug-resistance HIV-1 is transmissible and can be detected in up to 20% of newly infected individuals in countries with broad access to ART (Simon *et al.,* 2006). The possibility of spreading HIV-resistance, however, should not be used as an excuse for failing to provide treatment to patients in the developing world.

2.8.1.4 Management of opportunistic infections

Clinical experience in resource-poor settings indicates that most people with HIV come to healthcare facilities very late in their illness, usually when an opportunistic infection or wasting cannot be ignored (Gold, 2002). It is known that the immune reconstitution syndrome (the immune system begins to recover, but then responds to a previously acquired opportunistic infection with an overwhelming inflammatory response) may worsen an opportunistic infection (French and Price, 2001). It has been found that various infections may also spontaneously resolve in patients starting HAART, which indicates that effective viral suppression is associated with substantial immune reconstitution (Salas-Salvadó and García-Lorda, 2001). With any introduction or up-scaling of an ART programme, a pro-active process of early diagnosis and treatment of opportunistic infections should be integrated (Gold, 2002).

2.8.1.5 Alternative remedies

In general, any treatment method that is not practiced in conventional medication is considered complementary and alternative medicine (Dong and Imai, 2012:881). Dietary supplements, herbal treatments, megavitamins, acupuncture, yoga, and meditation are just a few of the therapies that are categorised as complementary and alternative medicine (Dong and Imai, 2012:881).

HIV-infected and AIDS patients often seek complementary therapies, which include herbal medicines (Liu *et al.,* 2005; Bormann, 2009) and thus the use of complementary and alternative medicine is prevalent in patients with HIV-infection (Dong and Imai, 2012:881). An average of 60% of people living with HIV/AIDS use complementary and alternative medicine to treat HIV-related health concerns (Littlewood and Vanable, 2008). As previously mentioned, certain foods including beetroot, onions, garlic, extra virgin olive oil and the African potato have been commonly recommended in HIV-infection in South Africa (Visser and Labadarios, 2004). There are some patients with HIV that have noted benefits with taking dietary supplements; however, potential interactions with ART medications should be addressed (see section 2.6.2.5) (Hendricks *et al.*, 2007).

Even though a high percentage of HIV-infected people use complementary and alternative medicine, only one third of patients disclose complementary and alternative medicine use to their healthcare providers (Liu *et al.*, 2009). One study found that 56% of patients had informed their physicians about using alternative therapies when asked, but the information was found in the medical charts of only 13% of the patients (Fenton and Silverman, 2008:1016). Other reasons for using alternative remedies might include unsatisfactory results, high cost, non-availability, or adverse effects of conventional medicines (Liu *et al.,* 2005). According to Saple *et al.* (2002), claims made by traditional healers to be able to cure HIV/AIDS lead a very large proportion of vulnerable patients away from ART. These therapies should be approached carefully as some products claim to be beneficial, but may in fact be harmful to health (Visser and Labadarios, 2004).

Certain herbs, including St John's Wort, which has been considered as safe, are now contra-indicated when used with ART (Visser and Labadarios, 2004). St John's Wort, an inducer of the cytochrome P450 pathway, decreases plasma concentrations of indinavir, which is metabolised in the cytochrome P450 pathway (Fenton and Silverman, 2008:1017). Drug resistance and treatment failure could occur because of this pharmacokinetic interaction.

Specific dietary supplements often used by this population include Echinacea, St John's Wort, cat's claw, protein supplements, creatine, anabolic steroids and Chinese herbs (Fenton and Silverman, 2008:1017). In a study performed in Norway, eight different herbal medicines were tested in patients with HIV-infection and AIDS. A component of Chinese herbs (IGM-1) showed significantly better effect than the placebo in improvement of health related quality of life, but a herbal formulation of 35 Chinese herbs did not affect CD4 cell counts, viral load or quality of life (Liu *et al.,* 2005). The herbs ginkgo biloba and ginseng, also frequently used by HIV/AIDS-infected patients, may both increase bleeding when taken with other blood-diluting medications or supplements (Visser and Labadarios, 2004). Other alternative treatments such as arginine, carnitine, coenzyme Q10, colostrum, dehydroepiandosterone, lipoic acid, N-acetylcysteine and whey protein have not been sufficiently evaluated (Visser and Labadarios, 2004).

There is insufficient evidence to support the use of herbal medicines in HIV-infected individuals and AIDS patients. Potential beneficial effects need to be confirmed in large, rigorous trials (Liu *et al.,* 2005). The Medical Research Council's (MRC) Traditional Medicine Unit has embarked on a study to establish safety and efficacy of three traditional products [DoH/MRC, 2008]. The National Reference Center for African Traditional Medicines was launched at the South African MRC and assists in identifying expertise and centers of excellence for research to be conducted and monitored on behalf of the Comprehensive HIV and AIDS Plan (DoH/MRC, 2008). Addressing alternative therapies should be a customary part of both the medical and nutrition assessment and intervention (Fenton and Silverman, 2008:1017).

2.8.2 Nutrition interventions

According to Dong and Imai, (2012:868), medical nutrition therapy is fundamental to successfully manage HIV. Nutritional support is needed in order to maintain optimal nutrition and to prevent further deterioration of nutritional status during acute episodes of infections. This will improve nutritional status during the stable symptom free period (Sherlekar and Udipi, 2002). Nutritional support can be achieved by nutritional assessment, nutritional screening, and nutritional intervention (Sherlekar and Udipi, 2002). The reasoning of providing nutritional support to AIDS patients is based upon assumptions that nutritional status can be improved and that such improvements might have clinical benefits (Kotler, 2000). Poor nutrition and HIV-related adverse health outcomes contribute to a vicious cycle that may be slowed down by using nutrition interventions (Fawzi *et al.,* 2005). According to Suttajit (2007), HIV-infected people should be informed about the basic concepts of optimal nutrition by identifying key food and nutrients, together with lifestyle changes, in order to contribute to a strengthened immune system.

In South Africa, the United Nations Children's Fund (UNICEF) is supporting the Nutrition Directorate to develop National guidelines for nutritional support for people with HIV/AIDS, including infant guidelines (WHO, 2009a). The South African DoH has compiled a manual on nutrition for people living with TB, HIV/AIDS and other chronic debilitating conditions (DoH, 2001). The Food Based Dietary Guidelines (FBDGs) emphasise the importance of healthy food choices and being physically active.

The FBDGs developed for South Africa, have been reviewed in relation to HIV-exposed and HIV-infected children (Hendricks *et al.,* 2007). The consequences of HIV-infection on nutritional status and nutritional requirements, as well as programmes and guidelines to address malnutrition were also investigated.

Recommendations should emphasise the improvement of dietary intake in using locally available and accessible resources for people with HIV/AIDS (FAO, 2003). Emphasis should also be given to the selection of food items that are rich in micronutrients that are important in the nutritional management of HIV/AIDS. Nutrition interventions, particularly vitamin supplementation, have the potential to be a low-cost method for enhancing the immune system (Mehta and Fawzi, 2007). Nutritional support for people with HIV/AIDS is currently provided through the PMtCT programme, the Integrated Nutrition Programme (INP), as well as the ARV programme for South Africa (Hendricks *et al.,* 2007).

To avoid malnutrition in people living with HIV/AIDS, nutritional counselling is of utmost importance and can assist in HIV-infected people to maintain body weight and improve quality of life (FAO, 2003). The ability to educate patients requires the nutrition counsellor to understand how the patient perceives himself or herself in a cultural context and in terms of HIV status (Torres *et al.*, 2008). Therefore it is important to incorporate local knowledge, expertise and lifestyle choices in order for nutrition education programmes to be effective (Brunner *et al.*, 2001, Torres *et al.*, 2008). Table 2.5 described education needed by HIV-infected patients.

Table 2.5: Education needed by HIV-patients (Dong and Imai, 2012:877)

Pregnancy, lactation, infancy and childhood
• Nutrition and food choices for healthy pregnancy and lactation
• Transmission risk in breastfeeding and replacement feeding alternatives
• Growth failure and development delay in children
• Support for normal growth trends in children
General lifestyle tips for adults
• Basic nutrition concepts and healthy habits
• Physical activity recommendations
• Body image and altered body weight and shape
• Nutrition and food-related knowledge related to cultural or ethnic practices
Nutrition interactions
• Prevention, restoration and maintenance of optimal body composition with an emphasis on lean tissues
• Medication-nutrition interactions
• Management of barriers to nutritional wellness, nutrition-related side effects of treatments, and symptoms requiring attention
• Review of oral beverage or nutrient supplements
• Review of potential interactions with nonprescription medications and herbal supplements
• Evaluation of interactions with alcohol and recreational drugs
Life skills and socio-economic issues
• Safe food handling and water sources
• Access to adequate food choices
• Food preparation skills and abilities

Adapted from American Dietetic Association, 2010: Position paper on nutrition intervention and Human Immunodeficiency Virus infection, *Journal of American Dietetics Association*, 110:1105.

2.9 PREVENTION PROGRAMMES

Sexually transmitted infections (STIs) are common in developing countries (Simon *et al.,* 2006) and STI and HIV-epidemics are interdependent. Frequent unprotected intercourse with different partners, places people at high risk of both infections, and there is clear evidence that conventional STIs increase the likelihood of HIV-transmission. Thus, identification and treatment of recently infected people is important in order to reduce transmission (Simon *et al.,* 2006).

A renewed emphasis on HIV-prevention is critically needed to prevent millions of new infections each year (UNAIDS, 2008). VCT plays an important role in the fight against the HIV/AIDS epidemic (Shisana *et al.*, 2009). As stated by Shisana *et al.* (2009), "VCT has been useful for encouraging people to test

and become aware of their HIV status; also providing HIV/AIDS-prevention education, particularly promoting safer sexual practices; and improving access to support services and antiretroviral treatment". Fear of being found HIV-infected may mean that people do not come back for results or deny that they received their results. This raises the need to address fear and stigmatisation as key components of the HIV-related programmes (SADHS, 2003:85).

Pregnant women should be tested for HIV, and if they are living with HIV, services and medication necessary need to be provided to ensure their health and reduce the risk of transmission to the child (UNAIDS, 2012). Among the 22 priority countries, Botswana, South Africa and Swaziland have achieved 90% coverage for preventing mother-to-child transmission with dual- and triple-therapy regimens (UNAIDS, 2012).

Poverty, however, also makes HIV-education difficult, due to poor people's lower levels of literacy and limited access to mass media and health and education services, especially in rural areas (FAO, 2003). Furthermore, people struggling with daily survival are less inclined to worry about the long-term implications of illness and therefore are less likely to take preventive measures.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

In this chapter, the design, sample, variables, techniques and procedures applied in the study are discussed. The methods for statistical analyses of the data are also included.

3.2 STUDY DESIGN

The study formed part of the Assuring Health for All (AHA) in the Free State study. A cross-sectional design was applied.

3.2.1 Sample selection

3.2.1.1 Population

The AHA-FS study was planned to coincide with the service learning functions of the University of the Free State. The key community service delivery site, namely the Free State Rural Development Partnership Programme (FSRDPP) as well as the Mangaung University Community Partnership Programme (MUCPP) comprised the setting for the study.

The AHA-FS study which was undertaken in rural Trompsburg, Philippolis and Springfontein (2007) and urban Mangaung (2009).

Rural

The rural areas included Trompsburg, Philippolis and Springfontein (part of the FSRDPP). The black and coloured areas in these towns were targeted as the population (excluding farms), due to the fact that they are in the process of experiencing transitions in lifestyle that have already been experienced

by the white populations. With the help of the local municipalities, the total number of persons was estimated as follows:

Trompsburg:	3000 Black, 400 Coloured
Philippolis:	2500 Black, 800 Coloured
Springfontein:	2500 Black, 600 Coloured

Urban

In 2007, the population of Mangaung was estimated at 752,906 persons or 202,762 households (Stats SA, 2008). The six black urban communities, which are serviced by the MUCPP were selected for the urban part of the study, namely one buffer community located close to MUCPP, as well as the communities of Freedom Square, Kagisanong, Chris Hani, Namibia and Turflaagte, which are all suburbs of the city, Bloemfontein.

The number of plots in the MUCPP service area was counted on a municipal map and an estimate made of additional squatter households in open areas. The total number of households (including squatter homes) in the six areas that are serviced by MUCPP were as follows:

Buffer:	345 formal
Freedom Square:	4791 formal + 300 squatter
Kagisanong:	651 formal + 50 squatter
Chris Hani:	1126 formal + 70 squatter
Namibia:	2011 formal + 60 squatter
Turflaagte:	2216 formal + 300 squatter

3.2.1.2 Sample

Rural

Every adult member of the household in these black and coloured communities, which met the following inclusion criteria, was eligible to participate:

- If informed consent was given;
- 25-64 years old

A total number of 499 households were included, including 552 adult participants.

Urban

Every adult member of the household in these black and coloured communities, which met the following inclusion criteria, was eligible to participate:

- If informed consent was given;
- 25-64 years old

A stratified proportional cluster sample was selected, stratified by area and formal plot/squatter households in open areas. Using randomly selected X and Y coordinates, one hundred starting points were selected in this way. From each starting point five adjacent households were approached. In each household all adults and pre-school children were eligible to participate. Table 3.1 describes the urban sample selection.

Table 3.1: Urban sample

Area	Formal		Informal	
	Included	**Total of households**	**Included**	**Total of households**
Buffer community	3	345	0	0
Freedom Square	40	4791	3	300
Kagisanong	6	631	0	50
Chris Hani	9	1126	1	70
Namibia	16	2011	1	60
Turflaagte	18	2215	3	300
Total	**92**		**8**	

3.3 MEASUREMENTS

3.3.1 Variables and operational definitions

Socio-demographic and household information (Appendix A) (one questionnaire per household):

For the purpose of this study, socio-demographic and household information variables included employment status; marital status; type of dwelling; water and sanitary conditions; assets; household income; and the proportion of income spent on food.

Household food security information (Appendix B) (one questionnaire per household):

For the purpose of this study, household food security included information related to agriculture, crop and livestock ownership; the distribution of food between household members; the degree of hunger in the household; and the coping strategies implemented by households in times of food insecurity.

Dietary intake information (Appendix C) (one questionnaire per adult):

For the purpose of this study a dietary diversity score (DDS) was calculated from a 24-hour recall for each participant of the number of portions from 12 possible food groups to classify dietary diversity as low (≤ 3), medium (4 and 5) or high (≥ 6) (FAO, 2003).

Physical activity information (Appendix D) (one questionnaire per adult):

For the purpose of this study physical activity level (PAL) was classified as: sedentary (1-1.39 PAL); low active (1.4-1.59 PAL); active (1.6-1.89 PAL); and very active (1.9-2.5 PAL).

Anthropometric information (Appendix E):

Anthropometric variables included height, weight, waist circumference (WC), mid-upper-arm-circumference (MUAC) and six skinfold thickness measurements, including triceps, biceps, supra-iliac, subscapular, thigh and calf.

Adults were categorised as underweight [BMI less than 18.5 kg/meter square (kg/m^2)]; normal weight (BMI 18.5 kg/m^2 or over, but less than 25 kg/m^2); overweight (BMI 25 kg/m^2 or over, but less than 30 kg/m^2); or obese (BMI 30 kg/m^2 or over) (Gibson, 2005:322).

A WC equal to or larger than 94 cm for men and 80 cm for women was considered as a high risk WC (Gibson, 2005:323).

MUAC measurements were categorised below the 15^{th} percentile, between the 15^{th} and 75^{th} percentile and above the 75^{th} percentile (Lee and Nieman, 2007:176).

A body fat percentage equal to or less than 5% for men and 8% for women was considered as unhealthy (too little body fat); a body fat percentage of 6-15% for men and 9-23% for women as acceptable lower-end range; a body fat percentage of 16-24% for men and 24-31% for women as acceptable upper end range; and a body fat percentage equal to or larger than 25% for men and 32% for women as unhealthy (too much body fat) (Lee and Nieman, 2007:330).

Reported health (Appendix F) (one questionnaire per adult):

For the purpose of this study, reported health referred to social support (group membership, network of friends, family structure); tobacco and alcohol consumption patterns; medical history and medications; family medical history; levels of stress and behaviours related to the control of stress.

Medical examination information (Appendix G):

Medical examination included heart rate, visible signs, cardiovascular abnormalities, respiratory abnormalities, abdominal pathology, nervous system abnormalities, skin pathology and HIV pre-test counselling. For the purpose of this sub-study, only blood pressure will be reported. In this study, hypertension was defined as a current blood pressure (BP) of systolic above 140 millimeter of mercury (mmHg) and/or diastolic above 90 mmHg (Conner *et al.,* 2005).

Biochemical information:

Laboratory determinations included full blood count, glycated haemoglobin (HbA1c), total cholesterol, HDL-cholesterol, triglycerides, fibrinogen, HIV status and CD4 cell count. Fasting glucose (normal value: fasting < 5.6 mmol/L) [WHO/International Diabetes Federation (IDF), 2009], HbA1c (normal value < 6.5%) [American Diabetes Association (ADA), 2010], serum triglyceride levels (normal value: fasting < 1.70 mmol/L), total cholesterol (normal value: fasting < 5.18 mmol/L), HDL (normal levels for men: > 1.0 mmol/L and women: > 1.3 mmol/L) and plasma fibrinogen [normal value: 1.5-4 gram per liter (g/L) (Dacie and Lewis, 1991:13)]. Low density lipoprotein (LDL)-cholesterol levels (normal value < 2.59 mmol/L) were calculated indirectly with the Friedewald equation, namely [(LDL-cholesterol) = (total cholesterol) − (HDL-cholesterol) − (triglyceride)/5] (Friedewald *et al.*, 1972).

3.3.2 Techniques

Questionnaires were used to collect information from household members in an interview with final year dietetics students. Where participants could not understand English or Afrikaans, a trained Sesotho-speaking interviewer assisted.

3.3.2.1 Socio-demographic information

A socio-demographic questionnaire was used to collect data. This questionnaire was adapted from the one developed for the Prospective Urban Rural Epidemiology (PURE) study (Teo *et al.*, 2009). The interviews were conducted by trained students and postgraduates from the Department of Nutrition and Dietetics at the University of the Free State, under the supervision of lecturers. A structured interviewing technique was used to complete the questionnaire in English with one adult member of each household. Where necessary, Afrikaans, Sesotho, Setswana and isiXhosa interpreters assisted the researchers.

3.3.2.2 Household food security information

A household food security and food procurement questionnaire was used to collect data and was adapted from the one developed for the PURE study (Teo *et al.*, 2009). The hunger scale used for the National Food Consumption Survey (NFCS) is based on a scale composed of eight questions that indicate whether adults and children in a household experience food shortages, perceive food insufficiency and alter food intake due to resource limitations or inadequate food resources (Gericke *et al.,* 2000). This tool was used to describe the prevalence of hunger experienced in households.

3.3.2.3 Dietary intake information

A 24-hour recall of usual intake was completed during individual interviews with all adults that participated in the study. The three main meals of the day were each evaluated according to what was eaten for breakfast, lunch and supper and then foods and drinks ingested between meals were added. Added foods such as sugar in tea, oil in mixed dishes or fried foods were also included.

Individual DDSs were calculated by means of a simple count of 12 possible food groups that an individual had consumed over the preceding 24 hours (FAO, 2011). In this study, the median intakes of HIV-infected and HIV-uninfected participants in rural and urban areas from the 16 food groups listed in the FAO (2011) list of food groups: 1) cereals; 2) vitamin A-rich vegetables and tubers; 3) white roots and tubers; 4) dark green leafy vegetables; 5) other vegetables; 6) vitamin A-rich fruit; 7) other fruits; 8) organ meat; 9) flesh meat); 10) eggs; 11) fish; 12) legumes, nuts and seeds; 13) milk and milk products; 14) oils and fats; 15) sweets; and 16) spices, condiments and beverages were determined together with the percentage of HIV-infected and HIV-uninfected participants in rural and urban areas that ingested foods from these 16 food groups. Because the purpose of this study was to determine dietary diversity and not nutrient adequacy, individual DDSs were calculated by means of a simple count of 12 food groups: 1) cereals; 2) white roots and tubers; 3) vitamin A-rich vegetables and tubers, dark green leafy vegetables and other vegetables; 4) vitamin A-rich fruit and other fruit; 5) organ meat and flesh meat; 6) eggs; 7) fish and seafood; 8) legumes, nuts and seeds; 9) milk and milk products; 10) oils and fats; 11) sweets; and 12) spices, condiments and beverages, that an individual had consumed over the preceding 24 hours. The individual level questionnaire included all food eaten by the individual of interest, consumed inside or outside the home, irrespective of where they were prepared.

3.3.2.4 Physical activity information

Level of physical activity was determined using a combination of a 24-hour physical activity recall and an adapted Baecke questionnaire (Baecke *et al.,* 1982), was completed in an individual interview with each adult. Participants were asked to mention all activities that they had performed during the previous day. From this the researchers calculated PALs for each participant as follows: the PAL values of various activities performed throughout the day were determined by adding the PAL for each activity. Due to the fact that not all activities were mentioned in the 24-hour recall, a short physical activity frequency form was used for cross-referencing. This procedure was followed for all activities and added to get a total PAL per week. The total PAL/week was then divided by seven to get the average PAL/day. All results were categorised according to the classification of Frary and Johnson, (2008, Table 2.2:24), adapted by the Institute of Medicine of the National Academies (2002). The

physical frequency questionnaire was used to identify any activities that participants might have participated in, but did not necessarily do within the last 24 hours.

3.3.2.5 Anthropometric information

All measurements were taken with respondents wearing an examination gown, without shoes. Anthropometric measurements were determined by trained dietetics students, using standardised methods (Lee and Nieman, 2007:170-201).

Height was measured using a stadiometer to the nearest 0.5 cm and weight was determined with a digital scale to the nearest 0.1 kg (Lee and Nieman, 2007:171-173).

WC was measured with a flexible, nonelastic tape measure to the nearest 0.5 cm (Lee and Nieman, 2007:188-189). WC was measured in a horizontal position, midway between the inferior margin of the ribs and the superior border of the iliac crest (Alberti *et al*., 2005).

MUAC was measured at the middle point, halfway between the acromion and the olecranon.

Triceps skinfold thickness was measured 1.0 cm above the midpoint of the triceps and biceps skinfold thickness was measured 1.0 cm above the midpoint of the bicep. Subscapular skinfold thickness was determined by taking a 45° angle measurement below and laterally to the angle of the shoulder blade. Suprailiac skinfold thickness was measured by taking a 45° angle measurement at the mid axillary line superior to the iliac crest. All measurements were recorded directly after the caliper reading stabilised (Lee and Nieman, 2007:171-173). The sum of the four skinfolds was used to determine body fat percentage (Durnin and Wormersley, 1974).

3.3.2.6 Reported health

An adult health questionnaire was completed for all adults in each household adapted from the one developed for the PURE study (Teo *et al.*, 2009). Information was collected in an interview with each adult by trained final year dietetics students, using a structured questionnaire.

3.3.2.7 Medical examination

Clinical information, including blood pressure, was collected by means of a medical examination performed by a medical practitioner and noted on a standard form. All physical examination and blood tests were done utilising standard methods; blood and urine samples were collected in the early morning with participants fasting.

3.3.2.8 Biochemical parameters

Respondents fasted overnight and blood samples were taken in the morning. In the rural study, blood and urine samples were collected by two chemical pathologists while in the urban leg of the study, blood and urine samples were collected by three registered nurses. All blood were analysed in an accredited laboratory using standard techniques. Sixty millimeters of blood was collected from each participant. Blood and urine samples were immediately stored in ice filled containers and transported to the laboratory. The National Health Laboratory Service (NHLS) Laboratory, University of the Free State (UFS) was responsible for analysis of the rural samples and a private pathology laboratory was responsible for analysis of the urban samples.

3.3.3 Validity and reliability

Validity refers to the degree to which a research procedure or assessment model measures what it is supposed to measure (Gibson, 2005:149). Reliability refers to the degree to which the same results can be reproduced after repeating the measurement (Gibson, 2005:129).

3.3.3.1 Questionnaires

To assure validity, all questions were related to the objectives of the study and questionnaires were developed based on issues discussed in the relevant literature.

Reliability was assessed by interviewing a random sample of 10% of selected participants for a second time (household questionnaire, food security questionnaire and health questionnaire). This took place one month after the initial interview. Where the percentage of given answers to questions differed with more than 20%, the question was considered unreliable. No unreliable questions were found,

except for one question about food stored in the urban sample (Appendix B: Household food security questionnaire).

3.3.3.2 Anthropometry

In order to ensure validity and reliability of results, all anthropometric measurements were determined in accordance with accepted published recommendations (Lee and Nieman, 2003:164–207). Scales were at the zero point before each measurement and the weight recorded by the scale was compared with a known weight. The scale was calibrated after every twentieth participant measured by the students. To ensure reliability, researchers used the standardised techniques recommended by Lee and Nieman (2007:170-201).

3.3.3.3 Medical examination

Medical examination included a valid clinical assessment of each participant. Reliability was assured by having qualified medical practitioners complete the medical examinations.

3.3.3.4 Biochemical parameters

All biochemical assessments were done utilising standard methods; blood and urine samples were collected in the early morning with participants fasting. Blood and urine samples were immediately stored in ice filled containers and transported to the laboratory. All samples were analysed using standard laboratory techniques.

The reliability of biochemical tests was assured by using standard laboratory techniques and controls.

3.3.4 Pilot study

Pilot studies were undertaken in five persons in each area, similar to the target group before the main survey in order to determine whether questions included in the questionnaire could be easily understood and to determine the amount of time needed to complete the questionnaires. All questionnaires and anthropometric measurements were piloted. Minor changes (mostly technical editing) were made to questionnaires after the pilot study.

3.3.5 Data collection process

Before data was collected, induction meetings for community members and other role-players were arranged in each community. The role-players included clinic staff, church leaders, community leaders and any members of the community who were interested in learning more about the project or had questions that they wanted to ask. The meetings were held in community halls or in the community clinic. At these meetings community members also provided the names of community members that could assist in informing other members of the community about the project. Separate training sessions were then arranged during which these community members were trained on how to explain the information document to community members that were eligible to participate and to obtain informed consent. These community members were also responsible for visiting eligible households on one or more occasions and advising participants on precautions to take before participation (e.g. arrive in a fasting state) and reminding participants of the day on which they were to visit the research venue. This was especially important in urban areas, where participants from different areas were scheduled to visit the research venue on different days.

Data collection took place at different research venues, including the community hall in the rural area or at the MUCPP nutrition centre in the urban area.

On days of data collection, ID documents were screened in order to make sure that the participants met the inclusion criteria for age. The research venues included stations for the collection of blood and urine samples; a food station; medical examination; as well as anthropometric measurements. All stations needed to be completed in order to be included in the study. Thereafter, questionnaires related to the following were completed: socio-demography (one per household); household food security (one per household); 24-hour recall (one for each participant); physical activity (one for each participant); and reported health (one for every participant).

3.3.6 Role of the researcher

Rural

The researcher assisted in compiling the dietary intake questionnaire. The researcher, together with final year dietetics students (23), two medical practitioners, and two chemical pathologists participated in data collection. During March 2007 the research team visited Trompsburg, Springfontein and Philippolis to collect data.

Together with the two medical practitioners, the researcher assisted with the medical examinations. The researcher was responsible for pre-test HIV counselling (Appendix H), before bloods were drawn for HIV-testing. The researcher also performed most blood pressure measurements, and assisted the medical practitioners with the medical examinations. After fieldwork was completed, the researcher was responsible for coding all medical examination questionnaires.

After the fieldwork in rural areas was completed, the researcher was responsible for evaluating and coding all dietary intake questionnaires (Appendix C). This included the 24-hour recall to determine intake during the past 24 hours, as well as the Food Frequency Questionnaire in which data related to how often foods are consumed was included. The researcher compiled a dietary diversity data form, and calculated the DDS for each participant.

Urban

The researcher assisted in compiling the dietary intake questionnaire. The researcher, together with final year dietetics students (19), other post-graduate students and three medical practitioners, and three registered nurses participated in the research project. During March 2009 the research team visited MUCPP to complete fieldwork in the urban area.

The researcher was responsible for pre-test counselling (Appendix H), performed most blood pressure measurements, and assisted the medical practitioners with medical examinations.

After fieldwork was completed, the researcher was responsible for coding all medical examination questionnaires. The researcher compiled a dietary diversity data form, and calculated the DDS for each participant.

3.4 STATISTICAL ANALYSIS

Descriptive statistics, including frequencies and percentages (for categorical data) and means and standards deviations (SDs) (for symmetrical numerical variables) or medians and percentiles (for skew numerical variables), were calculated. Where the "other" category was indicated by more than 5% of respondents, the given answers are indicated in the table. Differences between HIV-infected and HIV-uninfected rural groups, HIV-infected and HIV-uninfected urban groups, and HIV-infected urban respondents on ART and HIV-infected urban respondents not on ART were assessed by p-values [t-tests (for symmetrical numerical variables), Mann-Whitney tests (for skew numerical variables), chi-squared tests (for categorical variables) or Fischer's extract test (for categorical variables with sparse data)] or 95% confidence intervals (CIs) for median, mean or percentage differences. All analyses were performed by the Department of Biostatistics, University of the Free State. Logistic regression with forward selection ($p < 0.05$) was used to select significant independent factors associated with HIV status. Variables with a p-value of < 0.15 were considered for inclusion in the model. Age and gender were entered in each model as possible factors.

3.5 ETHICAL ASPECTS

The study was approved by the Ethics Committee of Faculty of Health Sciences, University of the Free State (ETOVS 21/07), as well as the Free State Department of Health (DoH) and local municipalities. The researchers obtained written information from all participants in their language of choice. Each household member received a participation letter in addition to the information document. This letter was used to inform them of the date they should attend the place of research to participate in

the study. The procedures were also described in this document (for example, fasting on arrival). Another purpose of this document was to inform employers why the employee would not be able to attend work on that specific day. Participants were given money for transport (R12) after they had completed all sections/stations on the data checklist. Those with pressing medical problems were referred directly after the examination. Communities were revisited by doctors after the results from laboratory investigations were available. During these follow-up appointments, participants were given their test results as well as referral letters if necessary. Patients with medical problems were referred to nearby clinics and community healthcare centres.

CHAPTER 4

Socio-Demographic Profile and Household Food Security of HIV-infected and HIV-uninfected Rural and Urban Communities in the Free State, South Africa

ABSTRACT

The influence of socio-demographic status and household food security on HIV-infection is immense, but remains largely undetermined in the Free State. The objective of this study was to determine significant independent socio-demographic and food security factors associated with HIV status in rural and urban communities in the Assuring Health for All (AHA) study which was undertaken in rural Trompsburg, Philippolis and Springfontein (2007) and urban Mangaung (2009).

Adults between 25-64 years were eligible to participate. Of the 567 rural participants, 97 (17.1%) were HIV-infected. Of the 424 urban participants, 172 (40.6%) were HIV-infected. Logistic regression with forward selection ($p < 0.05$) was used to select significant independent socio-demography and household food security factors associated with HIV status. Variables with a p-value of < 0.15 were considered for inclusion in the model.

For every year that age increased, the odds of having HIV decreased (by 8.0% in the rural sample and 7.0% in the urban sample). In rural areas, HIV-infection was negatively associated with having a microwave oven (odds ratio 0.15, 95% CI 0.06; 0.42); having access to vegetables from local farmers or shops (odds ratio 0.43, 95% CI 0.21; 0.89); and being married (odds ratio 0.20, 95% CI 0.09; 0.41). On the other hand, HIV-infection was positively associated with spending less than R50 on food per week (odds ratio 3.29, 95% CI 1.58; 6.87) or spending less than R100 on food per week (odds ratio 1.22, 95% CI 0.68; 2.20). In the urban sample, HIV-infection was also negatively associated with being married (odds ratio 0.54, 95% CI 0.33; 0.89), while HIV-infection was positively associated with experiencing periods of food shortages (odds ratio 2.14, 95% CI 0.91; 0.95).

A lower socio-economic status [spending very little on food (rural); and food shortage (urban)], are positively associated with HIV-infection. Interventions that focus on poverty alleviation can make a significant contribution to addressing the problem of HIV-infection in South Africa.

INTRODUCTION

Globally, the prevalence of Human Immunodeficiency Virus (HIV)-infection and Acquired Immune Deficiency Syndrome (AIDS) has increased steadily in all demographic groups, yet the epidemiologic data indicate that lower-income populations are most severely affected by the HIV (Kim *et al.,* 2001; Gillespie, 2008). In addition, gender and age dynamics play a large role in the spread of HIV-infection

[Academy of Science of South Africa (ASSAf), 2007:30], with strong evidence that socio-economic and gender inequalities increase the spread of HIV-infection (Gillespie, 2008; Poit, 2008). According to Gillespie (2008), gender is central to any discussion of HIV status and poverty. In developing countries, females are much more likely than males to have HIV-infection [Human Sciences Research Council (HSRC), 2004].

For 2011, Statistics South Africa (Stats SA) estimates the mid-year population as 50.6 million (Stats SA, 2012). The estimated overall HIV-prevalence is approximately 10.6% (Stats SA, 2012). The total number of people living with HIV is estimated at approximately 5.38 million in 2011. An estimated 16.6% of the adult population aged 15-49 years is HIV-infected (Stats SA, 2012). The total number of persons living with HIV in South Africa increased from an estimated 4.21 million in 2001 to 5.38 million by 2011. Approximately one-fifth of South African women in their reproductive ages are HIV-infected (Stats SA, 2012).

According to Fassin (2003) "humans live within a social order that is characterised by hierarchies and inequalities. AIDS, therefore, can be viewed as a social condition that not only unites human beings in common suffering, but also divides them in terms of exposure to risk and access to treatment" (Fassin, 2003). The lack of education or low educational level of many citizens in South Africa and neighbouring states in Southern Africa is associated with low or no income and limited purchasing power for the affected individuals (Sibanda *et al.* 2007; Ladzani, 2009). The recipients of disability grants generally belong to the black African population, which also tends to have lower levels of formal education (De Paoli *et al.*, 2012).

South Africa is a middle income country with a modern infrastructure and the largest economy in Africa [South African Demographic and Health Survey (SADHS), 2003], but has one of the highest levels of income inequality (Majumdar and Mazaleni, 2010). Unemployment and poverty are primary concerns for most people living with HIV/AIDS (De Paoli *et al.*, 2012). HIV-illness may prevent people living with HIV/AIDS from seeking work, and even if HIV-infected individuals are able to seek work, they are unlikely to find work given South Africa's high unemployment levels (De Paoli *et al.*, 2012).

HIV-prevalence is highest among South Africa's majority black African population, which also has the highest rate of unemployment and the lowest per capita income of all the racial groups (Seekings and Nattrass, 2005; DoH, 2007). Inability to go to work often results in the HIV-infected person's inability or limited ability to provide for the household due to the progressive nature of the disease (Ladzani, 2009). Unfortunately, one of the effects of HIV-infection is a person's frequent inability to go to work, thus reducing household income (Sibanda *et al.*, 2007).

Housing is one of the basic human needs and has both direct and indirect implications for households, including health, welfare and social status in communities (Stats SA, 2012). Household characteristics not only reflect the socio-economic status of the household, but also have environmental health implications (SADHS, 2003). The standard of housing, occupational density, access to clean safe water and sanitation, as well as the availability of adequate cooking and refrigeration facilities, may all contribute to an increased risk of malnutrition (ASSAf, 2007:27). Unfortunately, homelessness is a growing problem globally, intensified by higher rates of HIV-infection (Fenton and Silverman, 2008:994).

South Africa has a well-developed system of social security with social grants having expanded rapidly over the past years (Booysen, 2004). As reported by Johnson and Way (2006), household wealth status is likely to have an important independent relationship to HIV status. Poverty is a basic cause of undernutrition, because it is associated with unemployment; inability to pay for food, healthcare and basic services; disintegration of family life; inability to care for children; vulnerability; homelessness and hopelessness (ASSAf, 2007:25-16).

According to the United States Department of Agriculture (USDA) (2006), food security is defined as "access by all people at all times to enough food for an active, healthy life" and access to adequate food is threatened for all family members in HIV-affected households [Food and Agriculture Organisation (FAO), 2003]. Households experience food insecurity in the most basic sense when their resources are inadequate simply to obtain "enough food" in order to meet basic needs; the condition that in its severe form, results in hunger for household members (Keenan *et al.,* 2001).

A vicious cycle emerges in that poverty promotes the spread of HIV/AIDS; and conversely, HIV/AIDS contribute to continuing poverty (Lange and Van Der Waals, 2002). The nature and extent of the HIV-epidemic on food security are largely unknown (Sibanda *et al.*, 2007), but people's ability to develop and sustain themselves is disrupted (Poit, 2008). The HSRC report stated that all dimensions of food security, namely availability, stability, access to and use of food, are affected when the prevalence of HIV is high (Shisana *et al.*, 2005; Ladzani, 2009).

Although a number of studies have been conducted in South Africa to determine household food security in rural and urban households (Oldewage-Theron and Kruger, 2011; Oldewage-Theron *et al.,* 2006; Kruger *et al.,* 2006; Oldewage-Theron *et al.,* 2005; Lemke, 2005; Lemke *et al.,* 2003; Rose and Charlton, 2002a; Rose and Charlton, 2002b), information on the extent, degree and causes of the problem still remains limited (Hendriks, 2005; Lemke, 2005; Oldewage-Theron *et al.,* 2005; Rose and Charlton, 2002a). Nutrition security of individuals and households is influenced by various factors, specifically those related to the immediate environment. As stated by Labadarios *et al.* (2011), "South Africa should strive for all households to have access to food, water, sanitation and healthcare".

OBJECTIVES

This study formed part of the baseline phase of the Assuring Health for All in the Free State (AHA-FS) study which aims to determine how living in rural and urban communities can influence lifestyle and health. The present study investigated socio-demographic profile and household food security in HIV-infected and HIV-uninfected persons in rural and urban communities in the Free State. In addition, significant independent socio-demography and household food security factors associated with HIV status in this sample were determined.

METHODOLOGY

The rural study was performed in 2007 in three rural Free State towns, namely Trompsburg, Philippolis and Springfontein and the urban study in 2009 in Mangaung.

Study design

A cross-sectional study was undertaken.

Target population and sampling

In rural areas all households in black and coloured townships were eligible to participate. In urban Mangaung the number of plots in the Mangaung University Community Partnerships Programme (MUCPP) service area was counted on a municipal map and included Buffer, Freedom Square, Kagisanong, Chris Hani, Namibia and Turflaagte. An estimate was made of additional squatter households in open areas. A stratified proportional cluster sample was selected, stratified by area and formal plot/squatter households in open areas. Using randomly selected X and Y coordinates, one hundred starting points were selected in this way. From each point five adjacent starting households were approached to participate in the study. Every adult member of households in these black and coloured communities, who gave informed consent and were between the age of 25-64 years, were eligible to participate.

Pilot study

Pilot studies were undertaken in five persons in each area, similar to the target group before the main survey in order to determine whether questions included in the questionnaire could be easily understood and to determine the amount of time needed to complete the questionnaires. All questionnaires and anthropometric measurements were piloted. Minor changes (mostly technical editing) were made to questionnaires after the pilot study.

Variables and operational definitions

Variables included parameters of socio-demographic status (employment status; marital status; type of dwelling; water and sanitary conditions; assets; household income; and the proportion of income spent on food) and household food security (agriculture, crop and livestock ownership; the distribution of food between household members; the degree of hunger in the household; and the coping strategies implemented by households in times when experiencing food insecurity).

Methods and techniques

A Socio-Demographic Questionnaire and Household Food Security and Food Procurement Questionnaire were used to collect data. These two questionnaires were adapted from the one developed for the Prospective Urban Rural Epidemiology (PURE) study (Teo *et al.*, 2009). The hunger scale used for the National Food Consumption Survey (NFCS) is based on a scale composed of eight questions that indicate whether adults and children in a household experience food shortages, perceive food insufficiency and alter food intake due to resource limitations or inadequate food resources (Gericke *et al.,* 2000). This tool was used to describe the prevalence of hunger experienced in households. The interviews were conducted by trained students and postgraduates from the Department of Nutrition and Dietetics at the University of the Free State (UFS), under the supervision of lecturers. A structured interviewing technique was used to complete the questionnaire in English with one adult member of each household. Where necessary, Afrikaans, Sesotho, Setswana and isiXhosa interpreters assisted the researchers.

Validity and reliability

To assure validity, all questions were related to the objectives of the study and were based on issues discussed in relevant literature. Random samples of 10% of the rural and urban participants were interviewed a second time by the researchers to determine reliability of questions. Where the percentage of given answers to questions differed with more than 20%, the question was considered unreliable. No unreliable questions were found, except for one question about food stored in the urban sample (Appendix B: Household food security questionnaire).

Data collection

Before data was collected, induction meetings for community members and other role-players were arranged in each community. The role-players included clinic staff, church leaders, community leaders and any members of the community who were interested in learning more about the project or had questions that they wanted to ask. The meetings were held in community halls or in the community clinic. At these meetings community members also provided the names of community members that could assist in informing other members of the community about the project. Separate training sessions were then arranged during which these community members were trained on how to explain the information document to community members that were eligible to participate and to obtain informed consent. These community members were also responsible for visiting eligible households on one or more occasions and advising participants on precautions to take before participation (e.g. arrive in a fasting state) and reminding participants of the day on which they were to visit the research venue. This was especially important in urban areas, where participants from different areas were scheduled to visit the research venue on different days.

Data collection took place at different research venues, including the community hall in the rural area or at the MUCPP nutrition centre in the urban area.

On days of data collection, ID documents were screened in order to make sure that the participants met the inclusion criteria for age. The research venues included stations for the collection of blood and urine samples; a food station; medical examination; as well as anthropometric measurements. All stations needed to be completed in order to be included in the study. Thereafter, questionnaires related to the following were completed: socio-demography (one per household); household food security (one per household); 24-hour recall (one for each participant); physical activity (one for each participant); and reported health (one for every participant).

Ethics

The study was approved by the Ethics Committee of the Faculty of Health Sciences at the UFS (ETOVS 21/07) as well as the Free State Department of Health (DoH) and local municipalities. The researchers

obtained written information from all participants in their language of choice. Each household member received a participation letter in addition to the information document. This letter was used to inform them of the date they should attend the place of research to participate in the study. The procedures were also described in this document (for example, fasting on arrival). Another purpose of this document was to inform employers why the employee would not be able to attend work on that specific day. Rural and urban participants were given money for transport (R12) after they had completed all sections/stations on the data checklist. Those with critical medical problems were referred directly after the examination. Communities were revisited by doctors after the results from laboratory investigations were available. During these follow-up appointments, participants were given their test results as well as referral letters if necessary. Patients with medical problems were referred to nearby clinics and community healthcare centres.

Statistical analysis

Descriptive statistics, including frequencies and percentages (for categorical data) and means and standards deviations (SDs) (for symmetrical numerical variables) or medians and percentiles (for skew numerical variables), were calculated. Where the "other" category was indicated by more than 5% of respondents, the given answers are indicated in the table. Differences between HIV-infected and HIV-uninfected rural groups, HIV-infected and HIV-uninfected urban groups, and HIV-infected urban respondents on ART and HIV-infected urban respondents not on ART were assessed by p-values [t-tests (for symmetrical numerical variables), Mann-Whitney tests (for skew numerical variables), chi-squared tests (for categorical variables) or Fischer's extract test (for categorical variables with sparse data)] or 95% confidence intervals (CIs) for median, mean or percentage differences. All analyses were performed by the Department of Biostatistics, University of the Free State. Logistic regression with forward selection ($p < 0.05$) was used to select significant independent factors associated with HIV status. Variables with a p-value of < 0.15 were considered for inclusion in the model. Age and gender were entered in each model as possible factors.

RESULTS

Of the 570 rural participants, 567 had HIV results. Of these, 97 (17.1%) were HIV-infected. Of the 426 urban participants, 424 had HIV results. Of these, 172 (40.6%) were HIV-infected. Forty three of the 172 were on ART.

It should be noted that participants were included if all assessments or questionnaires had been completed. However, within questionnaires it was possible that not all questions had been answered, and for this reason missing values could occur (as indicated by n-values in tables).

Although not indicated in table format, the socio-demographic and food security results of urban participants on ART and those not on ART were also compared. Due to the low number of HIV-infected rural participants on ART, they were not included in the comparison of patients using ART and those not using ART. Twenty five percent (43 of 171 respondents) of HIV-infected urban respondents were using ART compared to only four HIV-infected respondents (4.1%) in rural areas.

In Table 4.1 the median age of rural and urban respondents is described. HIV-infected rural participants were significantly younger (median age 40.5 years) than HIV-uninfected rural participants (median age 51 years) (p = 0.001). HIV-infected urban participants were also significantly younger (median age 38 years) than HIV-uninfected urban participants (median age 49 years) (p = 0.0001). The median age of HIV-infected participants in rural areas were slightly higher than in urban areas at 40.5 and 38 years, respectively.

Table 4.1: Age of HIV-infected and HIV-uninfected rural and urban respondents

	HIV+						HIV-							
	N	**Median**	**25%**	**75%**	**Min**	**Max**	**N**	**Median**	**25%**	**75%**	**Min**	**Max**	**p-value[#]**	**95% CI**
Rural	92	40.5	34.0	49.5	27.0	65.0	455	40.0	51.0	57.0	25.0	65.0	0.001*	[-10; -5]
Urban	171	38.0	32.0	47.0	25.0	63.0	248	40.0	49.0	56.0	25.0	64.0	0.0001*	[-10; -6]

[#]p-value for median difference between HIV+ and HIV- participants using t-tests or Mann-Whitney, as appropriate

The median age of HIV-infected urban participants on ART was 38 years, which was very similar to those not on ART at 38.5 years.

Socio-demographic information of HIV-infected and HIV-uninfected rural and urban respondents

In Table 4.2 the gender, race, marital status, level of education, language and employment of respondents are shown. In both rural and urban areas, the percentage of female participants was higher than male participants. In rural areas HIV-infected participants tended to be female (73.0%) compared to male (27.0%). The same was found for HIV-uninfected rural participants with 80.5% female and 19.5% male participants. In the urban areas HIV-infected participants also tended to be female (78.0%) compared to male (22.0%). Similarly, a higher percentage of HIV-uninfected urban respondents were female (74.9%) compared to male (25.1%).

Table 4.2: Socio-demographic information of HIV-infected and HIV-uninfected rural and urban participants

Variable	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
Gender of respondent Rural: HIV+=91, HIV-=451; Urban: HIV+=168, HIV-=247										
Male	25	32.6	88	19.5	0.09	37	22.0	62	25.1	0.47
Female	66	72.5	363	80.5		131	78.0	185	74.9	
Race of family Rural: HIV+=92, HIV-=465; Urban: HIV+=172, HIV-=251										
Black	66	71.0	306	65.7		170	98.8	248	98.8	
Coloured	13	13.9	86	18.5	0.53	2	1.2	2	0.8	1.0
White	0	0.0	0	0.0		0	0.0	0	0.0	
Mixed	14	15.1	74	15.9		0	0.0	1	0.4	
Marital status Rural: HIV+=89, HIV-=451; Urban: HIV+=162, HIV-=244										
Child	1	1.12	2	0.4		0	0.0	0	0.0	
Never married	32	36.0	80	17.7		70	43.2	69	28.3	
Married/Traditional marriage	9	10.1	168	37.3	0.0001*	31	19.1	89	36.5	0.0002*
Living with partner	17	19.1	54	12.0		23	14.2	18	7.4	
Widowed	15	16.9	86	19.1		23	14.2	35	14.3	
Separated	11	12.4	43	9.5		6	3.7	12	4.9	
Divorced	4	4.5	17	3.8		8	4.9	21	8.6	
Other	0	0.0	1	0.2		1	0.6	0	0.0	

Table 4.2: Socio-demographic information of HIV-infected and HIV-uninfected rural and urban participants (continued)

Variable	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
Level of education of respondent Rural: HIV+=90, HIV-=439; Urban: HIV+=169, HIV-=244										
None	16	17.8	123	28.0		20	11.8	54	22.1	
Primary school	34	37.8	134	30.5		62	36.7	87	35.7	
Std 6-8	21	23.3	117	26.7	0.12	43	25.4	56	23.0	0.14
Std 9-10	18	20.0	59	13.4		37	21.9	44	18.0	
Tertiary education	1	1.1	2	0.5		1	0.6	2	0.8	
First language of household Rural: HIV+=93, HIV-=466; Urban: HIV+=172, HIV-=251										
Sesotho	33	35.5	149	32.0		117	68.0	138	55.0	
Tswana	0	0.0	3	0.6		17	9.9	45	17.9	
English	1	1.1	1	0.2	0.38	0	0.0	0	0.0	0.020*
Afrikaans	26	27.9	163	35.0		1	0.6	1	0.4	
Xhosa	33	35.5	150	32.2		37	21.5	67	26.7	
Employment status of respondent Rural: HIV+=93, HIV-=466; Urban: HIV+=172, HIV-=251										
Housewife by choice	1	1.1	14	3.0		1	0.6	2	0.8	
Unemployed	27	29.0	107	22.9	0.21	108	62.8	124	49.4	0.007*
Self employed	2	2.2	7	1.5		1	0.6	3	1.2	
Full time wage earner (receive a salary)	5	5.4	37	8.0		7	4.1	14	5.6	
Part-time job, piece job	58	62.4	301	64.6		55	32.0	108	43.0	
Not applicable e.g. dead	0	0.0	0	0.0		0	0.0	0	0.0	
Husband/ partner's employment status Rural: HIV+=93, HIV-=466; Urban: HIV+=172, HIV-=251										
Retired by choice	0	0.0	9	1.9		2	1.2	11	4.4	
Unemployed	13	13.9	48	10.3		27	15.7	27	10.8	
Self employed	0	0.0	1	0.2		5	2.9	4	1.6	
Full time wage earner (receive a salary)	5	5.4	52	11.2		12	7.0	32	12.8	
Part-time job, piece job	23	24.7	144	31.0	0.94	17	9.9	41	16.3	0.06
Not applicable e.g. dead	52	55.9	212	45.5		109	63.4	136	54.2	

[1]p-value for difference between HIV+ and HIV- rural participants using Chi-squared or Fisher's exact test, as appropriate

[2]p-value for difference between HIV+ and HIV- urban participants using Chi-squared or Fisher's exact test, as appropriate

In both rural and urban areas, the highest percentage of respondents was black. Almost all of the urban respondents (98.8%) were black compared to rural respondents where 71.0% were of black ethnicity. In rural areas 13.9% of respondents were coloured, while 15.1% of households in rural areas housed both black and coloured persons in the same household (mixed).

Overall, more HIV-uninfected people were married compared to HIV-infected participants. In the rural area, 37.3% HIV-uninfected participants were married compared to only 10.1% of HIV-infected participants, a difference which was statistically significant (p = 0.0001). Similarly, significantly more HIV-uninfected urban participants (36.5%) were married compared to HIV-infected participants (19.1%) (p = 0.0002).

A relatively high percentage of rural respondents had never attended school, ranging from 17.8% of HIV-infected rural participants to 28.0% of HIV-uninfected rural participants. A very small percentage of participants in both rural and urban areas had a tertiary education.

In terms of first language of households, the majority of urban participants spoke Sesotho, while in rural areas, a large percentage of respondents also spoke Afrikaans (27.9% of HIV-infected rural participants and 35.0% of HIV-uninfected participants). In urban areas, there was a statistically significant difference in the first language of HIV-infected and HIV-uninfected participants, with more HIV-infected participants speaking Sesotho compared to HIV-uninfected participants [68.0% versus (vs.) 55.0%] and less HIV-infected participants speaking Tswana than HIV-uninfected participants (9.9% vs. 17.9%) (p = 0.020).

In rural areas, the level of unemployment among HIV-infected adults (29.0%) was higher than among HIV-uninfected adults (22.9%), but the difference was not significant. In the urban area, the unemployment rate of HIV-infected adults was 62.8% which was significantly higher than in HIV-uninfected adults (49.4%) (p = 0.007). The percentage of full time wage earners was low in all groups, ranging from 4.1% of HIV-infected urban participants to 8.0% of HIV-uninfected rural participants. Among urban respondents, more HIV-uninfected participants (43.0%) had a part-time job compared to HIV-infected participants (32.0%).

In terms of husband or partner's employment status, results show similar patterns to the employment status of respondents. More partners of HIV-infected participants were unemployed in the rural group (13.9% vs. 10.3% in the HIV-uninfected group) and urban group (15.7% vs. 10.8% HIV-

uninfected participants). The percentage of full time wage earners (partners of HIV-infected respondents) was low in all groups. In the rural group, more HIV-uninfected partners (11.2%) were employed full-time compared to HIV-infected partners (5.4%). More HIV-uninfected partners (31.0% in rural areas and 16.3% in urban areas) had a part-time job compared to HIV-infected partners (24.7% in rural areas and 9.9% in urban areas).

In Table 4.3 the housing characteristics of HIV-infected and HIV-uninfected rural and urban participants are given. In both rural and urban areas, most households reported living in brick houses, ranging from 78.5% of HIV-infected rural participants to 84.6% of HIV-uninfected rural participants. More HIV-infected rural respondents (21.5%) lived in tin houses (shacks) compared to HIV-uninfected rural respondents (14.4%), but the difference was not significant.

A larger percentage of HIV-infected urban respondents (21.5%) had a high room density than HIV-uninfected urban respondents (16.4%). Significantly more HIV-uninfected urban respondents (17.1%) reported having a bathroom inside the house compared to HIV-infected urban respondents (8.7%) ($p = 0.01$). More than 90.0% of all households in both areas reported having a kitchen and more than 85.5% of all households in both areas reported having electricity.

In both rural and urban areas, the majority of households had their own tap, ranging from 76.7% of HIV-infected urban respondents to 96.4% of HIV-uninfected rural respondents. In rural households, almost all households used their own tap as the main source of drinking water. Most households reported having a flush type of toilet ranging from 83.1% of HIV-infected urban respondents to 94.6% HIV-uninfected rural respondents. HIV-infected urban respondents were slightly more likely to use a bucket or pot type of toilets (11.6%), compared to HIV-uninfected urban participants (8.4%).

Table 4.3: Housing characteristics of HIV-infected and HIV-uninfected rural and urban participants

Variable	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
Type of dwelling										
Rural: HIV+=93, HIV-=466; Urban: HIV+=172, HIV-=251										
Brick, concrete	73	78.5	394	84.6	0.15	142	82.6	210	83.7	0.76
Traditional mud	0	0.0	2	0.4		0	0.0	0	0.0	
Tin	20	21.5	67	14.4		30	17.4	40	15.9	
Plank, wood	0	0.0	0	0.0		0	0.0	0	0.0	
Other	0	0.0	3	0.6		0	0.0	1	0.4	
Median room density										
Rural: HIV+=93, HIV-=466; Urban: HIV+=172, HIV-=251										
$<$ 2.5 (not overcrowded)	82	88.2	414	88.8	0.85	135	78.5	210	83.7	0.17
$\geq$ 2.5 (over-crowded)	11	11.8	52	11.8		37	21.5	41	16.4	
Bathroom in house										
Rural: HIV+=93, HIV-=466; Urban: HIV+=172, HIV-=251	19	20.4	91	19.5	0.84	15	8.7	43	17.1	0.01*
Bathroom outside										
Rural: HIV+=93, HIV-=466; Urban: HIV+=172, HIV-=251	2	2.2	19	4.1	0.55	152	88.4	209	83.3	0.01
Kitchen or cooking area in house										
Rural: HIV+=93, HIV-=466; Urban: HIV+=172, HIV-=251	88	94.6	446	96.0	0.58	169	98.3	246	98.0	1.0
Has electricity										
Rural: HIV+=93, HIV-=466; Urban: HIV+=172, HIV-=251	83	89.3	438	94.2	0.079	147	85.5	222	88.5	0.36
Main source of drinking water										
Rural: HIV+=93, HIV-=466; Urban: HIV+=172, HIV-=251										
Own tap	88	94.6	449	96.4	0.39	132	76.7	201	80.1	0.41
Communal tap	4	4.3	15	3.2		39	22.7	47	18.7	
River, dam	0	0.0	1	0.2		0	0.0	0	0.0	
Borehole, well	0	0.0	0	0.0		0	0.0	2	0.8	
Other	1	1.1	1	0.2		1	0.6	1	0.4	
Type of toilet in household										
Rural: HIV+=93, HIV-=465; Urban: HIV+=172, HIV-=251										
Flush	86	92.5	440	94.6	0.42	143	83.1	221	88.1	0.15
Pit	0	0.0	3	0.7		5	2.9	7	2.8	
Bucket, pot	2	2.2	0	0.0		20	11.6	21	8.4	
VIP	0	0.0	15	3.2		2	1.2	2	0.8	
Other (neighbour's toilet)	5	5.4	7	1.5		2	1.2	0	0.0	

[1]p-value for difference between HIV+ and HIV- rural participants using Chi-squared or Fisher's exact test, as appropriate

[2]p-value for difference between HIV+ and HIV- urban participants using Chi-squared or Fisher's exact test, as appropriate

Table 4.4 reflects the household amenities of rural and urban participants. In the rural HIV-infected group, 57.6% reported using electricity as their main source of fuel for cooking compared to 65.2% in the HIV-uninfected rural group. More rural HIV-infected participants thus reported using paraffin as fuel for cooking (35.9%) compared to rural HIV-uninfected participants (29.3%).

Table 4.4: Household amenities of HIV-infected and HIV-uninfected rural and urban participants

Variable	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
Fuel used for cooking most of the time Rural: HIV+=93, HIV-=465; Urban: HIV+=172, HIV-=251										
Electric	53	57.6	303	65.2	0.14	132	76.7	202	80.5	0.35
Gas	3	3.3	20	4.3		1	0.6	2	0.8	
Paraffin	33	35.9	136	29.3		39	22.7	44	17.5	
Wood, coal	3	3.3	6	1.3		0	0.0	3	1.2	
Sun	0	0.0	0	0.0		0	0.0	0	0.0	
Open fire	0	0.0	0	0.0		0	0.0	0	0.0	
Home has a working Rural: HIV+=93, HIV-=466; Urban: HIV+=172, HIV-=251										
Refrigerator and/ or freezer	44	47.3	300	64.4	0.002*	116	67.4	188	74.9	0.09
Stove (gas, coal or electric)	66	70.9	368	79.0	0.08	137	79.7	209	83.3	0.34
Primus or paraffin stove	54	58.0	252	54.1	0.48	83	48.3	119	47.4	0.86
Microwave	6	6.5	110	23.6	0.002*	66	38.4	98	39.0	0.88
Radio	68	73.1	361	77.5	0.36	139	80.8	208	82.9	0.58
TV	36	38.7	275	59.0	0.0005*	116	67.4	176	70.1	0.55

[1]p-value for difference between HIV+ and HIV- rural participants using Chi-squared or Fisher's exact test, as appropriate

[2]p-value for difference between HIV+ and HIV- urban participants using Chi-squared or Fisher's exact test, as appropriate

A statistically significantly lower percentage of HIV-infected rural participants owned a refrigerator and/or freezer (47.3%) than HIV-uninfected rural respondents (64.4%) (p = 0.002). The same was found for owning a microwave (6.5% vs. 23.6%, p = 0.002) and television (38.7% vs. 59.0%, p = 0.0005).

Table 4.5 summarises income of rural and urban households. In both groups, one person most commonly contributed to the household income: 43.0% HIV-infected and 39.3% HIV-uninfected participants in rural areas and 33.7% HIV-infected and 37.5% HIV-uninfected urban participants.

In rural areas, household income differed significantly between HIV-infected respondents and HIV-uninfected respondents (p = 0.005). More HIV-infected participants in the rural group received an income between R100 – R500 (24.7%) compared to HIV-uninfected participants in the same group (10.7%). Few HIV-infected rural participants had a household income between R1001 – R3000 (33.3%) than HIV-uninfected rural participants (45.5%). The same trend was seen in the urban group, but the difference in urban income was not significant. More than 16.0% of HIV-infected rural respondents reported lower income over six months preceding the survey.

Table 4.5: Income information of HIV-infected and HIV-uninfected rural and urban participants

Variable	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
Number of people that contribute to income Rural: HIV+=93, HIV-=465; Urban: HIV+=172, HIV-=251										
0	2	2.2	11	2.4		9	5.2	12	4.8	
1	40	43.0	183	39.3		58	33.7	94	37.5	
2	32	34.4	190	40.8		58	33.7	62	24.7	
3	17	18.2	59	12.7		22	12.8	49	19.5	
4	0	0.0	14	3.0	0.92	16	9.3	19	7.6	0.76
5	0	0.0	5	1.1		6	3.5	10	4.0	
6	2	2.2	3	0.7		2	1.2	4	1.6	
7	0	0.0	1	0.2		0	0.0	0	0.0	
8	0	0.0	0	0.0		1	0.6	1	0.4	
Household income per month Rural: HIV+=93, HIV-=466; Urban: HIV+=172, HIV-=251										
None	1	1.1	7	1.5		5	2.9	6	2.4	
R100 – R500	23	24.7	50	10.7		50	29.1	48	19.1	
R501 – R1000	32	34.4	168	36.0		46	26.7	75	29.9	
R1001 – R3000	31	33.3	212	45.5	0.005*	60	34.9	104	41.4	0.081
R3001 – R5000	2	2.2	17	3.7		3	1.7	7	2.8	
Over R5000	3	3.2	7	1.5		2	1.2	5	2.0	
Don't know	1	1.1	5	1.1		6	3.5	6	2.4	
Income over past six months Rural: HIV+=93, HIV-=465; Urban: HIV+=172, HIV-=251										
More	4	4.3	26	5.6		3	1.7	2	0.8	
Less	15	16.1	72	15.5	0.87	10	5.8	11	4.4	0.46
Same	74	79.6	367	78.9		159	92.4	238	94.8	

[1]p-value for difference between HIV+ and HIV- rural participants using Chi-squared or Fisher's exact test, as appropriate

[2]p-value for difference between HIV+ and HIV- urban participants using Chi-squared or Fisher's exact test, as appropriate

Socio-demographic information of HIV-infected urban respondents on ART and not on ART

No statistically significant differences in gender, race, marital status, level of education, language and employment occurred between participants on ART and not on ART.

Significant differences in room density (34.9% vs. 17.1%, p = 0.01), having a kitchen or cooking area in the house (93.0% vs. 100.0%, p = 0.01), and using an own tap as source of drinking water most of the time (65.1% vs. 80.6%, p = 0.02), occurred between urban respondents on ART and not on ART.

No significant differences in the percentage of participants on ART and not on ART were found in terms of household amenities.

In terms of household income per month, more respondents on ART reported receiving a higher income when compared to respondents not on ART treatment. Seven percent of participants not on ART had received lower income over six months preceding the survey, compared to 2.3% of respondents not on ART treatment. None of these differences were, however, significant.

Household food security and food procurement among HIV-infected and HIV-uninfected rural and urban respondents

In Table 4.6, expenditure and source of income of rural and urban participants are described. In rural areas the differences in expenditure on food differed significantly between HIV-infected and HIV-uninfected participants (p = 0.004). A larger percentage of HIV-infected rural respondents spent R50 or less on food for the household per week (22.2%), compared to HIV-uninfected rural respondents (8.8%). Therefore, a higher percentage of HIV-uninfected rural participants spent between R101 – R150 per week on food (30.4%) than HIV-infected rural respondents (14.4%). Very few rural respondents spent more than R201 per week on food for the household. A similar pattern that was also significant was reported in urban areas (p = 0.04). A larger percentage of HIV-infected urban respondents spent R50 or less on food for the household per week (13.9%), compared to HIV-uninfected urban respondents (8.9%), while higher percentage of HIV-uninfected urban participants spent between R101 – R150 per week on food (15.0%) than HIV-infected urban respondents (10.8%).

Table 4.6: Source of income and expenditure of HIV-infected and HIV-uninfected rural and urban participants

Variable	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
Money spent on food for the household weekly Rural: HIV+=90, HIV-=457; Urban: HIV+=166, HIV-=216										
R0-R50	20	22.2	40	8.8		23	13.9	22	8.9	
R51-R100	30	33.3	143	31.3		27	16.3	30	12.1	
R101-R150	13	14.4	139	30.4		18	10.8	37	15.0	
R151-R200	12	13.3	66	14.4	0.004*	12	7.2	21	8.5	0.04*
R201-R250	6	6.7	27	5.9		19	11.5	29	11.7	
R251-R300	0	0.0	11	2.4		7	4.2	11	4.5	
R301-R350	2	2.2	4	0.9		3	1.8	5	2.0	
R351-R400	2	2.2	8	1.7		0	0.0	5	2.0	
Over R400	2	2.2	6	1.3		11	6.3	24	9.7	
Don't know	2	2.2	13	2.8		46	27.7	63	25.5	
Main source of income of household Rural: HIV+=90, HIV-=457; Urban: HIV+=165, HIV-=247										
1. Wages and salaries from formal employment	8	8.9	45	9.9		12	7.3	21	8.5	
2. Self employment (including home enterprises	0	0.0	7	1.5		0	0.0	0	0.0	
3. Casual employment (agricultural or non agricultural)	13	14.4	50	10.9		22	13.3	15	6.1	
4. Crop production and livestock sales	0	0.0	0	0.0		0	0.0	3	1.4	
5. Sale of assets	0	0.0	0	0.0		0	0.0	0	0.0	
6. Land/ flats /equipment rental	0	0.0	0	0.0		0	0.0	0	0.0	
7. Old age pension or state grant	59	65.6	308	67.4	0.73	85	51.5	117	47.4	0.41
8. Domestic work	1	1.1	1	0.2		0	0.0	2	0.8	
9. Other (family supports/ sick pension/ unemployed/ husband's salary/ piece job)	9	10.0	46	10.1		46	27.9	89	36.0	

[1]p-value for difference between HIV+ and HIV- rural participants using Chi-squared or Fisher's exact test, as appropriate

[2]p-value for difference between HIV+ and HIV- urban participants using Chi-squared or Fisher's exact test, as appropriate

In both rural and urban groups the percentage of respondents with wages and salaries from formal employment was relatively low, ranging from 7.3% in HIV-infected urban respondents to 9.9% in HIV-uninfected rural respondents. A high percentage of both groups received an old age pension or state grant, ranging from 47.4% in HIV-uninfected urban participants to 67.4% in HIV-uninfected rural participants. When comparing urban participants, a higher percentage of HIV-infected urban

respondents received an old age pension or state grant (51.5%), compared to HIV-uninfected urban respondents (47.4%), however the difference was not statistically significant.

Table 4.7 summarises production, preservation and availability of vegetables, crops and fruit trees in rural and urban communities. In rural areas, more HIV-uninfected participants were likely to grow vegetables (45.3%) than HIV-infected participants (34.4%). The opposite was noted in the urban areas where HIV-infected respondents were more likely to grow vegetables (40.1%) when compared to HIV-uninfected respondents (34.8%). Significantly more HIV-infected urban participants (26.9%) grew cabbage compared to HIV-uninfected urban participants (14.0%) (p = 0.02).

Table 4.7: Food production, preservation and availability of HIV-infected and HIV-uninfected rural and urban participants: Vegetables, crops and fruit trees

Variable	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
Vegetables grown										
Rural: HIV+=90, HIV-=457; Urban: HIV+=167, HIV-=247										
1=yes	31	34.4	207	45.3	0.06	67	40.1	86	34.8	0.27
2=no	59	66.2	250	54.7		100	59.9	161	65.2	
Types of vegetables produced										
Rural: HIV+=31, HIV-=207; Urban: HIV+=67, HIV-=86										
1. Cabbage	11	35.5	66	31.9	0.57	18	26.9	12	14.0	0.02*
2. Carrots	22	71.0	127	61.4	0.51	12	17.9	22	25.6	0.53
3. Green, leafy vegetables	25	80.7	176	85.0	0.05	66	98.5	80	93.0	0.13
4. Pumpkin	12	38.7	87	42.0	0.19	15	22.4	18	20.3	0.53
5. Beans	8	25.8	84	40.6	0.02*	15	22.4	16	18.6	0.10
6. Beetroot	18	58.1	127	61.4	0.12	20	29.9	26	30.2	0.64
Crops grown										
Rural: HIV+=90, HIV-=457; Urban: HIV+=167, HIV-=247										
1=yes	21	23.3	107	23.4	0.98	14	8.4	19	7.7	0.79
2=no	69	76.7	350	76.6		153	91.6	228	92.3	
Types of crops produced										
Rural: HIV+=21, HIV-=107; Urban: HIV+=14, HIV-=19										
1. Maize	10	47.6	64	59.8	0.46	3	21.4	3	15.8	0.62
2. Wheat	0	0.0	2	1.9	1.0	0	0.0	0	0.0	
3. Sorghum	0	0.0	0	0.0		1	7.1	0	0.0	0.41

Table 4.7: Food production, preservation and availability of HIV-infected and HIV-uninfected rural and urban participants: Vegetables, crops and fruit trees (continued)

Variable	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
4. Potatoes	13	61.9	68	63.6	0.91	11	78.6	19	100.0	0.67
5. Other	1	4.8	4	3.7	0.16	0	0.0	0	0.0	
Fruit trees owned Rural: HIV+=90, HIV-=457; Urban: HIV+=167, HIV-=247										
1=yes	61	67.8	319	69.8	0.76	68	40.7	107	43.3	0.59
2=no	29	32.2	138	30.2		99	59.3	140	56.7	
Types of fruit grown Rural: HIV+=61, HIV-=318; Urban: HIV+=68, HIV-=107										
1. Peaches Rural: HIV+=47, HIV-=260; Urban: HIV+=61, HIV-=89	54	88.5	288	90.6		55	80.1	95	88.8	
2. Apricots Rural: HIV+=47, HIV-=261; Urban: HIV+=61, HIV-=89	19	32.2	120	38.1		23	33.8	33	30.8	
3. Grapes	10	16.9	84	26.6		7	10.3	14	13.1	
4. Apples	10	16.9	33	10.4		11	16.2	12	11.2	
5. Oranges	1	1.7	1	0.3		3	4.4	1	0.9	
6. Other	0	0.0	0	0.0		0	0.0	0	0.0	

[1]p-value for difference between HIV+ and HIV- rural participants using Chi-squared or Fisher's exact test, as appropriate

[2]p-value for difference between HIV+ and HIV- urban participants using Chi-squared or Fisher's exact test, as appropriate

Significantly more HIV-uninfected rural participants grew beans (40.6%) than HIV-infected rural participants (25.8%) (p = 0.02), while significantly more HIV-infected urban respondents grew cabbage (26.9%) than HIV-uninfected respondents (14.0%) (p = 0.02). Potatoes, the crop most often grown, ranged from 61.9% in HIV-infected rural respondents to 100% in HIV-uninfected urban respondents.

Rural participants were more likely to have their own fruit trees than urban participants, however the difference was not significant. In all areas participants tended to plant peach trees, followed by apricot, grapes and apple trees.

Table 4.8 reflects the availability of livestock in rural and urban areas. In terms of owning livestock, a higher percentage of HIV-uninfected respondents reported owning livestock compared to their HIV-infected counterparts (24.8% vs. 15.6% in rural areas and 7.3% vs. 4.8% in urban areas), but these differences were not statistically significant.

Table 4.8: Food production, preservation and availability of HIV-infected and HIV-uninfected rural and urban participants: Livestock

Variable	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
Livestock owned Rural: HIV+=90, HIV-=456; Urban: HIV+=167, HIV-=247										
1=yes	14	15.6	113	24.8	0.05	8	4.8	18	7.3	0.31
2=no	76	84.4	343	75.2		159	95.2	229	92.7	

[1]p-value for difference between HIV+ and HIV- rural participants using Chi-squared or Fisher's exact test, as appropriate

[2]p-value for difference between HIV+ and HIV- urban participants using Chi-squared or Fisher's exact test, as appropriate

In Table 4.9, food preservation and availability in rural and urban communities is described. With respect to producing enough food to last until the next season, numbers were very low in rural areas: 22.7% for HIV-infected and 27.1% for HIV-uninfected respondents. In urban areas this question was found to be unreliable and results are not reported. Higher percentages of rural respondents reported keeping food for future use (68.2% of HIV-infected and 74.8% of HIV-uninfected participants). In the urban areas, 58.3% of HIV-infected urban respondents and 57.5% HIV-uninfected urban respondents kept food for future use.

In rural areas, a higher percentage of HIV-infected respondents compared to HIV-uninfected respondents tended to sun dry (44.2% vs. 36.0%) or can (32.6% vs. 25.9%) it in order to keep food for future use, while more HIV-uninfected respondents compared to HIV-infected respondents froze food for future use (28.1% vs. 14.0%). In all groups the main reason for producing food was for consumption by family members.

Most respondents reported fairly high availability of fruit and vegetables from local farmers and shops. Significantly more HIV-uninfected rural participants reported a high availability of vegetables (90.4%) than HIV-infected participants (80.0%) ($p = 0.004$).

Table 4.9: Food preservation and availability of HIV-infected and HIV-uninfected rural and urban participants

Variable	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
Enough food produced to last until the next season Rural: HIV+=66, HIV-=373										
1=yes	15	22.7	101	27.1	0.24					
2=no	51	77.3	272	72.9						
Food kept for future use Rural: HIV+=66, HIV-=373; Urban: HIV+=96, HIV-=146										
1=yes	45	68.2	279	74.8	0.25	56	58.3	84	57.5	0.90
2=no	21	31.8	94	25.2		40	41.7	62	42.5	
Main reason for producing food Rural: HIV+=62, HIV-=363; Urban: HIV+=92, HIV-=142										
1. Consumption by family members	58	93.6	337	92.8	0.61	90	97.8	138	97.2	0.70
2. To sell	0	0.0	11	3.0		2	2.2	4	2.8	
3. To exchange for clothes and household equipment	0	0.0	0	0.0		0	0.0	0	0.0	
4. Other	4	6.4	15	4.1		0	0.0	0	0.0	
Fruits easily available from the local farmers and shops Rural: HIV+=90, HIV-=456; Urban: HIV+=166, HIV-=246										
1=yes	75	83.3	409	89.7	0.08	147	88.6	225	91.5	0.34
2=no	15	16.7	47	10.3		19	11.4	21	8.5	
Vegetables easily available from the local farmers and shops Rural: HIV+=90, HIV-=456; Urban: HIV+=166, HIV-=246										
1=yes	72	80.0	412	90.4	0.004*	147	88.6	226	91.	0.25
2=no	18	20.3	44	9.6		19	11.4	20	8.1	
Form of transport mainly use to buy food Rural: HIV+=90, HIV-=457; Urban: HIV+=167, HIV-=247										
1. Foot	77	85.6	376	82.3	0.08	96	57.5	121	48.9	0.45
2. Bicycle	0	0.0	3	0.7		0	0.0	0	0.0	
3. Public transport e.g. taxi	8	8.9	51	11.2	0.52	71	42.5	125	50.6	0.11
4. Car	3	3.3	12	2.6		0	0.0	1	0.4	
5. Other	2	2.2	15	3.3		0	0.0	0	0.0	

[1]p-value for difference between HIV+ and HIV- rural participants using Chi-squared or Fisher's exact test, as appropriate

[2]p-value for difference between HIV+ and HIV- urban participants using Chi-squared or Fisher's exact test, as appropriate

Most rural respondents walked to buy food, while urban respondents either walked to buy food or made use of public transport. A higher percentage of HIV-infected rural participants tended to walk compared to HIV-infected urban participants (85.6% vs. 57.5%), while a higher percentage of HIV-infected urban respondents reported frequent use of public transport compared to HIV-infected rural respondents (42.5% vs. 8.9%) respectively.

Table 4.10 reflects the hunger scale of rural and urban respondents. In all areas a high percentage of respondents reported running out of money to buy food, with significantly more HIV-infected urban respondents (92.2%) than HIV-uninfected urban respondents (85.0%) ($p = 0.03$) reporting this. In rural and urban areas, a high percentage of HIV-infected respondents relied on a limited number of foods to feed their children. In the urban area, there was a significant difference in the percentage of HIV-infected and HIV-uninfected respondents that had to rely on a limited number of foods to feed their children ($p = 0.04$). Most participants in all areas had to cut the size of meals, or ate less because there was not enough food in the house or not enough money to buy food.

Table 4.10: Hunger scale of HIV-infected and HIV-uninfected rural and urban respondents

Variable	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
Household run out of money to buy food										
Rural: HIV+=90, HIV-=457; Urban: HIV+=167, HIV-=247										
1.yes	61	67.8	338	74.0	0.36	154	92.2	210	85.0	0.03*
2.no	29	32.2	119	26.0		13	7.8	37	15.0	
Rely on a limited number of foods to feed children										
Rural: HIV+=63, HIV-=342; Urban: HIV+=134, HIV-=210										
1.yes	28	44.4	125	36.6	0.23	113	84.3	158	75.2	0.04*
2.no	35	55.6	217	63.5		21	15.7	52	24.8	
Cut the size of meals or skip any because there is not enough food										
Rural: HIV+=89, HIV-=457; Urban: HIV+=167, HIV-=247										
1.yes	63	70.8	325	71.1	0.95	132	79.0	183	74.1	0.24
2.no	26	29.2	132	28.9		35	21.0	64	25.9	

Table 4.10: Hunger scale of HIV-infected and HIV-uninfected rural and urban respondents (continued)

Variable	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
Eat less than you should because there is not enough money for Rural: HIV+=90, HIV-=457; Urban: HIV+=167, HIV-=247										
1.yes	58	64.4	261	57.1	0.19	134	80.2	183	74.1	0.14
2.no	32	35.6	196	42.9		33	19.8	64	25.9	
Participant or children eat less than they feel they should because there is not enough money for Rural: HIV+=62, HIV-=342; Urban: HIV+=132, HIV-=206										
1.yes	24	38.7	91	26.6	0.05	103	78.0	150	72.8	0.28
2.no	38	61.3	251	73.4		29	22.0	56	27.2	
Children say they are hungry because there is not enough food Rural: HIV+=62, HIV-=342; Urban: HIV+=133, HIV-=206										
1.yes	22	35.5	70	20.5	0.009*	103	77.4	139	67.5	0.04*
2.no	40	64.5	272	79.5		30	22.6	67	32.5	
Cut the size of your children's meals or skip meals because there is not enough money to buy food Rural: HIV+=62, HIV-=342; Urban: HIV+=132, HIV-=206										
1.yes	18	29.0	61	17.8	0.05	101	76.5	147	71.4	0.29
2.no	44	71.0	281	82.2		31	23.5	59	28.6	
Children ever go to bed hungry because there is not enough money to buy food Rural: HIV+=90, HIV-=457; Urban: HIV+=167, HIV-=247										
1.yes	10	16.1	35	10.3	0.18	92	68.2	119	57.2	0.04*
2.no	52	83.9	306	89.7		43	31.9	89	42.8	
3. no children in household	28	31.1	115	25.2		32	19.1	39	15.8	
Family ever experienced periods of food shortage Rural: HIV+=90, HIV-=457; Urban: HIV+=167, HIV-=247										
1.yes	38	42.2	217	47.5	0.36	145	86.8	188	76.1	0.07
2.no	52	57.8	240	52.5		22	13.2	59	23.9	

Table 4.10: Hunger scale of HIV-infected and HIV-uninfected rural and urban respondents (continued)

Variable	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
Coping skills during periods of food shortage Rural: HIV+=38, HIV-=212; Urban: HIV+=145, HIV-=188										
1.Found other/additional sources of income	1	2.3	9	4.3		7	4.8	9	4.8	1
2.Asked family/ relatives/ neighbours for help (money/ food)	24	63.2	115	54.3		86	59.3	112	59.6	24
3.Family members went to live elsewhere	0	0.0	1	0.5		23	15.9	32	17.0	0
4.Sold assets	0	0.0	0	0.0		0	0.0	0	0.0	0
5.Worked for payment in kind	6	15.8	12	5.7		1	0.7	0	0.0	6
6.Depended on charity/ welfare	0	0.0	1	0.5		2	1.4	2	1.1	0
7.Borrowed money/ food	7	18.4	48	22.6		17	11.7	30	16.0	7
8.Increased production of food	0	0.0	3	1.4		0	0.0	0	0.0	0
9.Could not do anything	0	0.0	6	2.8		6	4.1	3	1.6	0
10.Other (credit at store/ family members bring food)	0	0.0	17	8.0		3	2.1	0	0.0	0
Family member served first Rural: HIV+=90, HIV-=457; Urban: HIV+=167, HIV-=247										
1. Father/ men in the family.	12	13.3	65	14.2		33	19.8	53	21.5	
2. Mother/ women in the family	13	14.4	44	9.3		9	5.4	10	4.1	
3. Children	5	5.6	34	7.4		34	20.4	53	21.5	
4.All eat at the same time	46	51.1	282	61.7		78	46.7	112	45.3	
5.Lives and eats alone	14	15.6	32	7.0		13	7.8	19	7.7	

[1]p-value for difference between HIV+ and HIV- rural participants using Chi-squared or Fisher's exact test, as appropriate

[2]p-value for difference between HIV+ and HIV- urban participants using Chi-squared or Fisher's exact test, as appropriate

In both rural and urban areas, a large percentage of households with HIV-infected participants reported that children had to eat less because there was not enough money compared to HIV-uninfected participants. This tended to be significant in rural areas (38.7% vs. 26.6%, p = 0.05). Significantly more HIV-infected respondents than HIV-uninfected respondents reported that children said that they were hungry because there was not enough food in the house (rural: 35.5% vs. 20.5%, p = 0.009 and urban: 77.4% vs. 67.5%, p = 0.04). More HIV-infected rural participants reported cutting the size of the children's meals or skipping meals (29.0%) than HIV-uninfected rural participants (17.8%), but the difference only tended to be significant (p = 0.05). Significantly more HIV-uninfected

urban respondents reported that their children did not go to bed hungry compared to HIV-infected urban respondents (68.2% vs. 57.2%, p = 0.04).

A large percentage of rural respondents reported periods of food shortage (42.2% of HIV-infected respondents and 47.5% of HIV-uninfected respondents). In the urban area it was much higher with more HIV-infected respondents reporting periods of food shortage (86.8%) compared to HIV-uninfected respondents (76.1%). During periods of food shortage, more than 50% of respondents in all areas asked family, relatives or neighbours for help with money and/or food, with a higher percentage for HIV-infected rural participants (63.2%) than HIV-uninfected rural participants (54.3%). HIV-infected rural respondents were more likely to work for payment in kind (15.8%) compared to HIV-uninfected rural respondents (5.7%). In rural areas, a higher percentage of HIV-infected participants (15.6%) lived and ate alone than HIV-uninfected rural participants (7.0%).

Household food security and food procurement of HIV-infected urban respondents on ART and not on ART

A higher percentage of HIV-infected urban respondents on ART spent between less than R50 on food per week (20.0%) compared to those not on ART (11.9%), but the differences in money spent on food by the two groups was not statistically significant.

Significantly more respondents on ART reported casual employment (25.0%) when compared to participants not on ART (6.7%) (p = 0.013). In turn, a higher percentage of respondents not on ART reported another source of income (34.3%) compared to those using ART (15.0%). No significant differences in parameters of food production, preservation and availability occurred between HIV-infected urban participants on ART and not on ART.

Very few HIV-infected urban respondents reported owning livestock, ranging from 2.4% of participants on ART to 5.6% of participants not on ART. No significant differences were found in the percentages of respondents on ART and not on ART that owned livestock.

When asked of the kept food for future use, a higher percentage of participants not on ART did so (63.0%) than those on ART (43.5%), but the difference was not statistically significant (p = 0.09).

Participants on ART were more likely to run out of money to buy food and had to rely on a limited number of foods to feed their children. None of these differences, however, reached statistical significance.

As far as the hunger scale was concerned, a higher percentage of HIV-infected urban respondents on ART generally reported experiencing food shortage (95.1%) than those not on ART (84.1%). Although the p-value indicates a trend, the difference was not statistically significant (p = 0.07). A higher percentage of HIV-infected urban respondents not on ART asked family, relatives or neighbours for help (63.2%) than HIV-infected urban respondents on ART (48.7%), but more participants on ART reported that they borrowed money or food (25.6%) compared to those not on ART (6.6%).

Socio-demographic and household food security factors associated with HIV status

In addition to descriptive comparisons between HIV-infected and HIV-uninfected participants, logistic regression was used to identify significant socio-demographic and food security factors associated with HIV status.

Socio-demographic and household food security factors associated with HIV status in rural participants

The following socio-demographic variables were considered for inclusion:

Education (none vs. others), type of dwelling (brick/concrete, traditional mud, tin, other), fuel used for cooking (electric, gas, paraffin, wood/coal), home has working stove/hot plate (yes vs. no), home has working microwave (yes vs. no), home has working television (yes vs. no), household income per month (R500 or less, R501-R100, R1001-R3000, R3001 and more), marital status (married vs. not). The following variables were selected in the model: age, marital status and microwave.

The following household food security variables were considered for inclusion:
Money spent on food for household weekly (up to R50, R51-R100, R101 and more), grow vegetables (yes vs. no), growing green, leafy vegetables (yes vs. no), growing pumpkins (yes vs. no), growing beans (yes vs. no), growing beet (yes vs. no), own livestock (yes vs. no), fruits easily available from local farmers/shops (yes vs. no), are vegetables easily available from local farmers and shops (yes vs. no), form of transport used to buy food (foot, bicycle, public transport, car, other), ever eat less that you should because there is not enough money for food (yes vs. no) , do your children ever eat less than you feel they should because there is not enough money for food (yes vs. no), do any of the children ever say they are hungry because there is not enough food in the house (yes vs. no), do you ever cut the size of children's meals or do they skip meals because there is not enough money to buy food (yes vs. no). The following variables were selected in the model: age, money spent on food for household weekly, are vegetables easily available from local farmers and shops.

Thereafter the variables which were significant in the socio-economic and household food security models, namely age, marital status, microwave, money spent on food for household weekly, are vegetables easily available from local farmers and shops, were considered for the final model. All these variables were selected in the model with odds ratios as indicated in Table 4.11.

Table 4.11: Socio-demographic and household food security factors associated with HIV status (rural)

Variable		Odds ratio (95% CI)	p-value
Age		0.92 (0.90; 0.95)	<0.0001
Microwave	yes vs. no	0.15 (0.06; 0.42)	0.0002
Vegetables easily available from local farmers and shops	yes vs. no	0.43 (0.21; 0.89)	0.0224
Marital status	married vs. not	0.20 (0.09; 0.41)	<0.0001
Money spent on food	up to R50 vs. R101+	3.29 (1.58; 6.87)	0.0040
	R51-R100 vs. R101+	1.22 (0.68; 2.20)	

In this rural sample, for every year that age increased the odds of having HIV decreased (by 8%). As far as socio-demographic and food security indicators in this rural sample are concerned, HIV-infection was negatively associated with having a microwave oven, having access to vegetables from local farmers or shops, and being married. On the other hand, HIV-infection was positively associated

with spending less than R50 on food per week (odds ratio 3.29) or spending less than R100 on food per week (odds ratio 1.22).

Socio-demographic and household food security factors associated with HIV status in urban participants

The following socio-demographic variables were considered for inclusion:

Education (none vs. others), employment status (unemployed vs. not), partner's employment status (other vs. the rest), home has working refrigerator / freezer (yes vs. no), household income (R500 or less, R501-R100, R1001-R3000, R3001 and more), marital status (married vs. other). The following variables were selected in the model: age and marital status.

The following household food security variables were considered for inclusion:

Money spent on food for household weekly (up to R50, R51-R100, R101 and more), growing cabbages (yes vs. no), growing green/leafy vegetables (yes vs. no), growing beans (yes vs. no), does household ever run out of money to buy food (yes vs. no), rely on limited number of foods to feed your children (yes vs. no), ever eat less that you should because there is not enough money for food (yes vs. no) , children ever eat less than you feel they should because there is not enough money for food (yes vs. no), children ever go to bed hungry because there is not enough money to buy food (yes vs. no), children ever say they are hungry because there is not enough food in the house (yes vs. no), family ever experienced periods of food shortage (yes vs. no). The following variables selected in the model: age, has the family ever experienced periods of food shortage, grow green/leafy vegetables.

Thereafter the variables which were significant in the socio-economic and household food security models (namely age, marital status, family ever experienced periods of food shortage, and grow green/ leafy vegetables) were considered for the final model. Age, marital status and family ever experienced periods of food shortage were selected in the model with odds ratios as indicated in Table 4.12.

Table 4.12: Socio-demographic and household food security factors associated with HIV status (urban)

Variable		Odds ratio (95% CI)	p-value
Age		0.93 (0.91; 0.95)	<0.0001
Periods of food shortages	yes vs. no	2.14 (1.19; 3.85)	0.0116
Marital status	married vs. not	0.54 (0.33; 0.89)	0.0152

In this urban sample, for every year that age increased the odds of having HIV decreased (by 7%). As far as socio-demographic and food security indicators in this urban sample were concerned, HIV-infection was negatively associated with being married (odds ratio 0.54). On the other hand, HIV-infection was positively associated with experiencing periods of food shortage (odds ratio 2.14).

DISCUSSION

HIV-infected rural and urban participants were significantly younger than their HIV-uninfected counterparts. According to the Centers for Disease Control and Prevention (CDC) (2012), a number of factors, such as social and economic factors that include poverty, lack of access to healthcare, stigma and discrimination, contribute to the high levels of HIV in young people. Young people between the ages of 13 and 24 represent more than a quarter of new HIV-infections each year (26%) and most of these youth living with HIV (60%) are unaware that they are infected (CDC, 2012).

Blacks are in the majority (40.2 million) and constitute just more than 79.5% of the total South African population (Stats SA, 2012). The coloured population is estimated at 4,5 million (9%), the white population at 4.6 million (9%) and the Indian/Asian population at 1.3 million (2.5%). Approximately 52% (approximately 26.1 million) of the population is female (Stats SA, 2012). In the current study, the percentage of female respondents that participated was higher than male respondents. Possible reasons include the fact that more women tend to stay home compared to men, due to employment status or family responsibilities and were thus more easily available to participate. Women were also more likely to bring children to a research venue where free healthcare services were rendered. A larger percentage of urban women were also HIV-infected compared to rural women. According to

the United States Agency for International Development (USAID) (2006), most-at-risk populations (such as those in urban areas) engage in behaviours that put them at higher risk for HIV-infection. Johnson and Way (2006) found that men and women living in rural areas in Kenya were half as likely to be HIV-infected compared to those in urban areas. Although many researchers regard urban residence as a key risk marker, the potential for HIV-spread in rural areas should not be ignored (Johnson and Way, 2006).

As far as socio-demographic indicators in this rural and urban sample are concerned, HIV status was negatively associated with being married, probably due to having fewer sexual partners. A relatively high percentage of respondents in all groups of this study had never attended school. Evidence from Uganda showed that a child who drops out of school is three times more likely to become HIV-infected in his or her twenties than a child who completes his or her basic education (UNAIDS, 2008). The SADHS 2003 showed that people who lived in urban areas had about three times the level of achieved tertiary qualifications compared to those living in rural areas (SADHS, 2003:15). This may be a reflection of residential differences related to access to tertiary institutions, affordability, post-study employment opportunities, and possibly also reflects the higher proportions of older persons living in rural areas, as well as the fact that older persons tend to have lower levels of education. The South African Census of 2011 showed a steady increase in the percentage of households living in formal dwellings over time; the percentage of households living in traditional dwellings has almost halved while the percentage of households living in informal dwellings has decreased from 16.2% in 1996 to 13.6% in 2011 (Stats SA, 2012).

The current study results showed that poverty was prevalent in both HIV-infected and HIV-uninfected groups, but HIV-infected persons in both rural and urban areas were generally poorer and had a high level of food insecurity. This concurs with a study done by Bachmann and Booysen (2003) where households with an HIV-infected member were compared with unaffected neighbouring households, in a rural and urban area in the Free State province, South Africa. It was found that HIV-affected rural households tended to be poorer and to have lower employment rates than unaffected urban households. In the present study, a larger percentage of HIV-infected respondents lived in

overcrowded households than HIV-uninfected respondents. In contrast, Johnson and Way (2006) found that in Kenya, wealth was positively related to being HIV-infected, with those in the wealthiest category being three times more likely to be infected than those in the poorest category. However, this finding has not been confirmed in South Africa where the poorest of the poor are more likely to practice risky behaviours to provide resources for survival. Poverty is a basic cause of undernutrition, because it is associated with unemployment; inability to pay for food, health care and basic services; disintegration of family life; inability to care for children; vulnerability; homelessness and despair (ASSAf, 2007:25-16). A vicious cycle develops in that poverty promotes the spread of HIV/AIDS; and conversely, HIV/AIDS contributes to poverty that continues to exist (Lange and Van Der Waals, 2002). At the end of 2008, the official unemployment rate among the black population was 25.9%, with unemployment in the townships even higher (Stats SA, 2009). In another South African study reported by De Paoli *et al.* (2012), among HIV-infected participants living in townships in the Western Cape province, high levels of unemployment among both HIV-infected and HIV-uninfected individuals were reported.

HIV status in this rural sample was negatively associated with having a microwave oven. Significantly fewer HIV-infected rural participants owned a refrigerator and/or freezer, microwave and television. Refrigerators and/or freezers, microwaves and television are more likely to be owned by higher-income individuals. In addition, household income in rural areas differed significantly between HIV-infected respondents and HIV-uninfected respondents. More HIV-infected rural adults received an income of less than R500 per month compared to HIV-uninfected rural and were less likely to have a household income above R1001 compared to HIV-uninfected rural participants. The same trend was seen in the urban group, but the difference in urban income was not significant. A study performed in the Bushbuckridge District (Limpopo province, South Africa) found that most households earned less than R1000 per month, well below the poverty line (defined in 2001 as an income of R1541 per month for a household of five) (Saloojee *et al.*, 2007; HSRC, 2004). Sufficient income is necessary to ensure that enough food can be obtained to meet the requirements of a household and therefore income is an important determinant of a household's ability to meet food security needs (Hendriks, 2005; Coutsoudis *et al.*, 2000).

An association between low income, food insecurity and nutrient inadequacies has been reported by Kirkpatrick and Tarasuk (2008). In the present study, expenditure on food in rural areas differed significantly between HIV-infected and HIV-uninfected participants. A larger percentage of HIV-infected rural respondents spent R50 or less on food for the household per week, compared to HIV-uninfected rural respondents, while very few rural respondents spent more than R201 per week on food for the household. This study found that HIV status was positively associated with spending less than R50 on food per week or spending less than R100 on food per week. A similar pattern was reported in urban areas, and these differences were also significantly different. In this study, the main source of income in all areas was old age pension or state grant, as very few participants relied on wages and salaries from formal employment. The South African government is providing the elderly with an old age pension, which was intended to be a poverty relief programme for the aged (Legido-Quigley, 2003). However, it has turned into a household poverty alleviation programme also benefiting the younger generation.

Food production, preservation and availability of fruit and vegetables

According to the International Food Security Assessment 2011-2021, food production at household level is important in assuring food security in sub-Saharan Africa (USDA, 2011). Although not optimal, HIV-uninfected rural participants in this study were more likely to grow crops, have their own fruit trees and kept their own livestock compared to HIV-infected rural participants. Even though HIV-infected rural respondents spent less money on food, they grew significantly more cabbage than HIV-uninfected respondents. Most respondents in this study reported fairly high availability of fruit and vegetables from local farmers and shops. In this rural sample, HIV-infection was negatively associated with having access to vegetables from local farmers or shops. This may be due to higher food security. Most participants had to walk to buy food or use public transport in urban areas. In other studies, the high cost of public transport and long distances to supermarkets has been documented as the main reason for low fruit and vegetable consumption (DeRose *et al.*, 1999).

In all groups the main reason for producing food was for consumption by family members. Domestic food production continues to be the key determinant of food security in the sub-Saharan Africa

region in the short-term (USDA, 2011). HIV/AIDS-affected households may compromise their long-term adaptability through selling assets such as livestock or land to buy food (FAO, 2003; Drimie, 2002; Rugalema, 2000) and changing their cultivation practices towards less profitable, more labor-efficient crops (Donovan *et al*, 2005; Muwanga, 2002).

Food security

Food insecurity was common in both rural and urban communities included in this study, with the problem of food insecurity being worse in HIV-infected participants. In the current study, a higher percentage of HIV-infected respondents reported running out of money to buy food (rural and urban), relied on a limited number of food to feed their children (urban), reported eating less than they wanted to (rural) and tended to eat less than they should because there was not enough money for food (rural and urban), compared to HIV-uninfected participants. In addition, a larger percentage of households with HIV-infected participants reported that children had to eat less because there was not enough money (rural and urban) and experienced food shortage (rural) than HIV-uninfected counterparts.

Household food insecurity remains a major concern in developing countries, resulting in hunger and undernutrition (Rose and Charlton, 2002a). In South Africa, National food security is assured (Steyn *et al.,* 2001; Coutsoudis *et al.,* 2000), however, many households experience hunger and food and nutrition insecurity due the factors contributing to poverty and underdevelopment (ASSAf, 2007:26). Rose and Charlton (2002a) reported household food insecurity in 43.0% of households in South Africa, while Parikh (2000) reported a very similar percentage of 44.0%. In addition, more than 14 million South Africans (35.0% of the population) are estimated to be vulnerable to food insecurity (HSRC, 2004). Despite projections that food security will improve in most of the world in the next ten years (based on food production and import capacity of countries). The International Food Security Assessment for 2011 to 2021 (USDA, 2011) estimated that the number of food insecure people in sub-Saharan Africa will increase by 17 million between 2011 and 2021. Although significant progress has been made in recent years in some areas of nutrition, 790 million people in the developing world and 34 million in developed countries are still undernourished and do not have enough to eat (FAO, 1999).

As far as food security indicators in this urban sample are concerned, HIV status was positively associated with experiencing periods of food shortages and might be due to increased HIV-infection in a situation of acute food insecurity (Gillespie and Kadiyala, 2005). In the present study periods of food shortage and hunger occurred commonly, especially in HIV-infected respondents. In the NFCS of 1999, more than half of South African households reported hunger, almost a quarter were at risk of hunger and only a quarter reported being food secure (Labadarios *et al.*, 2005). In the NFCS, food purchasing practices were determined by means of a food procurement questionnaire, while hunger was assessed by a modified hunger scale questionnaire, very similar to the one used in the current study.

In a study by Kaschula (2011), in a rural settlement area in North-Eastern KwaZulu Natal, South Africa, households reported high levels of food insecurity. Evidence from the study done by Kaschula (2011) suggests that households with both chronic poverty and chronic illness (with or without HIV/AIDS) were particularly prone to food insecurity. According to Hamelin *et al.* (1999), coping strategies during times of food insecurity may include relying on credit to buy food, selling personal assets, skipping meals, limiting portion sizes, buying and preparing limited foods, and parents depriving themselves to feed children (Hamelin *et al.*, 1999). In the current study coping strategies reported included asking family, neighbours or relatives for help (in terms of money or food) or borrowing money or food.

We acknowledge there is a certain degree of bias regarding the age of rural volunteers in the study. Older and unemployed individuals were more likely to participate. More women than men participated in the study probably due to men being labourers and formally employed and therefore not available for interviews conducted during the day. It is also possible that ill persons may have been more likely to participate in the study where medical examinations were conducted due to limited health services, especially in rural areas. Due to these reasons, the authors acknowledge that the study group is probably not representative of the general population.

Another limitation is that patients were grouped into the two groups comparing urban participants on ART and not on ART, based on report of medication use. Duration of ART use was, however, not assessed.

CONCLUSIONS

HIV-infected persons in both rural and urban areas were generally poorer and had a high level of food insecurity. Indicators of lower socio-economic status [such as not having a microwave oven, limited access to vegetables (except cabbage), limited amount of money to buy food and experiencing periods of food shortage] were positively associated with HIV status.

A vicious cycle develops, with poverty increasing the likelihood of contracting HIV/AIDS and HIV/AIDS contributing to poverty. Interventions that focus on poverty alleviation can make a significant contribution to addressing HIV in South Africa.

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CHAPTER 5

Dietary Diversity and Physical Activity of HIV-infected and HIV-uninfected Rural and Urban Communities in the Free State, South Africa

ABSTRACT

Dietary diversity is associated with improved socio-economic status and household food security, both of which impact on nutritional status and health. In HIV-infected individuals, poor nutritional status increases fatigue and physical inactivity. The objective of this study was to determine significant independent nutritional factors associated with HIV-infection in rural and urban communities in the Assuring Health for All (AHA) study. The AHA study was undertaken in rural Trompsburg, Philippolis and Springfontein (2007) and urban Mangaung (2009).

Adults between 25-64 years were eligible to participate. Of the 567 rural participants, 97 (17.1%) were HIV-infected. Of the 424 urban participants, 172 (40.6%) were HIV-infected. Logistic regression with forward selection ($p < 0.05$) was used to select significant independent dietary diversity and physical activity factors associated with HIV status. Variables with a p-value of < 0.15 were considered for inclusion in the model.

In rural areas, for every year that age increased the odds of having HIV-infection decreased (by 7.0%). One out of five participants had low and medium dietary diversity scores. HIV-infection was negatively associated with a person consuming no eggs (odds ratio 0.41, 95% CI 0.20; 0.82) and consuming no sweets (odds ratio 0.19, 95% CI 0.04; 0.85) (rural). On the other hand, HIV-infection was positively associated with being sedentary versus very active (odds ratio 3.18, 95% CI 1.31; 7.70); low active versus very active (odds ratio 2.27, 95% CI 1.08; 4.77); and active versus very active (odds ratio 2.44, 95% CI 1.31; 4.55) (rural).

Being physically inactive [indicated by being sedentary versus very active; low active versus very active; and active versus very active], was positively associated with HIV-infection in the rural sample of this study, probably because lower levels of physical activity are an outcome of HIV-infection.

INTRODUCTION

Eating a variety of foods is recommended in practically all national and global food-based dietary guidelines [World Health Organisation (WHO), 1998], because a diet which is sufficiently diverse reflects adequacy (Kennedy, 2009). Poor populations struggle most to eat a diverse diet as they consume a typically monotonous diet based on starchy staple foods, containing little or no animal products, dairy, and fruits and vegetables, resulting in multiple nutrient deficiencies (Ruel, 2002).

Food variety is usually quantified by the number of different food items eaten (Bernstein *et al.*, 2002), while dietary diversity is quantified by the number of food groups (e.g. grains, meats, fruits, dairy products and vegetables) consumed over a certain period (Kant *et al.,* 1993). The more food groups included in the daily diet, the greater the possibility of meeting nutrient requirements (Labadarios *et al.*, 2011). The assessment of dietary diversity has been proposed as an indicator of food security, since income and food access are strongly related [Food and Agriculture Organisation (FAO), 2011; Hoddinot and Yohannes, 2012; Oldewage-Theron and Kruger, 2011]. A consistent positive association has been reported between the number of foods (i.e. food variety) and food groups (i.e. dietary diversity) consumed and adequacy of nutrient intake (Torheim *et al.*, 2003; Torheim *et al.,* 2004; Hatløy *et al.*, 1998).

Inadequate dietary diversity in poor populations in the developing world contributes to the problem of multiple nutrient deficiencies (Ruel, 2002). Repetitive or monotonous diets, based mainly on starches (e.g. maize and bread), and diets that often include little or no animal products and few fresh fruits and vegetables have been closely associated with food insecurity (Kennedy, 2009; Ruel, 2002).

On the other hand, studies have shown that improved socio-economic status and household food security (household energy availability) is associated with an increase in dietary diversity (Hoddinot and Yohannes, 2002; Hatløy *et al*., 2000). In patients with Human Immunodeficiency Virus (HIV)/ Acquired Immune Deficiency Syndrome (AIDS), poor dietary intake often occurs in the presence of poverty and lack of food in the household (WHO, 2005; Kirkpatrick and Tarasuk, 2008). Lack of access to adequate, affordable, safe and nutritious food is an important determinant of malnutrition (FAO, 2003). Therefore, a compromised nutritional status is often an outcome of poor dietary diversity and food insecurity (Ladzani, 2009).

Malnutrition increases fatigue and physical inactivity in already HIV-infected persons (Piwoz and Preble, 2000). Earlier studies have reported that exercise in HIV-infected persons may lead to improved psychological well-being, functional aerobic capacity, quality of life indices, cardiovascular profile, body cell mass and strength with decreases in body fat (O'Brien *et al.*, 2004; Hand *et al.*, 2008;

Mutimura *et al.*, 2008; Smith *et al.,* 2001). Physical activity also plays a vital role as a preventative measure for overweight and obesity in the lives of young (Kruger *et al.,* 2003) and adult (Cook *et al.,* 2005) individuals, and is thus an important component in the management of lipodystrophy. It is increasingly being supported that exercise and increased levels of physical activity are an essential component of the treatment regimen of HIV-infected individuals (Jones *et al.,* 2001). The reason for this is that exercise may be used to address unwanted changes in weight and body composition in HIV-infected people (O'Brien *et al.,* 2004) and has been used successfully to treat psychological conditions such as depression and anxiety that are common in HIV-infected individuals (Dudgeon *et al.,* 2004).

The present study investigated dietary diversity and levels of physical activity in HIV-infected and HIV-uninfected persons in rural and urban communities in the Free State province. In addition, significant independent dietary diversity and physical activity factors associated with HIV status in this sample were determined.

METHODOLOGY

The rural study was undertaken in 2007 in three rural Free State towns, namely Trompsburg, Philippolis and Springfontein and the urban study commenced in 2009 in Mangaung. A cross-sectional study design was adopted.

Target population and sampling

In rural areas all households in black and coloured townships were eligible to participate. In urban Mangaung the number of plots in the Mangaung University Community Partnerships Programme (MUCPP) service area was counted on a municipal map and included Buffer, Freedom Square, Kagisanong, Chris Hani, Namibia and Turflaagte. An estimate was made of additional squatter households in open areas. A stratified proportional cluster sample was selected, stratified by area and formal plot/squatter households in open areas. Using randomly selected X and Y coordinates, one

hundred starting points were selected in this way. From each point five adjacent starting households were approached to participate in the study.

Every adult member, between the ages of 25-64 years of the households in these black and coloured communities, who signed informed consent, was eligible to participate.

Pilot study

Pilot studies were undertaken in five persons in each area, similar to the target group before the main survey in order to determine whether questions included in the questionnaire could be easily understood and to determine the amount of time needed to complete the questionnaires. All questionnaires and anthropometric measurements were piloted. Minor changes (mostly technical editing) were made to questionnaires after the pilot study.

Variables and operational definitions

For the purpose of this study, a dietary diversity score (DDS) was calculated from 12 possible food groups to classify dietary diversity as low (≤ 3), medium (4 and 5) or high (≥ 6).

Physical activity level (PAL) was classified as sedentary (1-1.39 PAL), low active (1.4-1.59 PAL), active (1.6-1.89 PAL) and very active (1.9-2.5 PAL).

Methods and techniques

A 24-hour recall was completed during individual interviews with all adults that participated in the study. The three main meals of the day were each evaluated according to what was eaten for breakfast, lunch and supper and then foods and drinks ingested between meals were added. Added foods such as sugar in tea, oil in mixed dishes or fried foods were also included.

Individual DDS were calculated by means of a simple count of 12 possible food groups that an individual had consumed over the preceding 24-hours (FAO, 2011). In this study, the median intakes of HIV-infected and HIV-uninfected participants in rural and urban areas from the 16 food groups listed in the FAO (2011) list of food groups 1) cereals; 2) vitamin A-rich vegetables and tubers; 3)

white roots and tubers; 4) dark green leafy vegetables; 5) other vegetables; 6) vitamin A-rich fruit; 7) other fruits; 8) organ meat; 9) flesh meat); 10) eggs; 11) fish; 12) legumes, nuts and seeds; 13) milk and milk products; 14) oils and fats; 15) sweets; and 16) spices, condiments and beverages, were determined together with the percentage of HIV-infected and HIV-uninfected participants in rural and urban areas that ingested foods from these 16 food groups. Because the purpose of this study was to determine dietary diversity and not nutrient adequacy, individual DDS were calculated by means of a simple count of 12 food groups: 1) cereals; 2) white roots and tubers; 3) vitamin A-rich vegetables and tubers, dark green leafy vegetables and other vegetables; 4) vitamin A-rich fruit and other fruit; 5) organ meat and flesh meat; 6) eggs; 7) fish and seafood; 8) legumes, nuts and seeds; 9) milk and milk products; 10) oils and fats; 11) sweets; and 12) spices, condiments and beverages, that an individual had consumed over the preceding 24-hours. The individual level questionnaire included all food eaten by the individual of interest, consumed inside or outside the home, irrespective of where they were prepared.

Level of physical activity was determined using a combination of a 24-hour physical activity recall and an adapted Baecke questionnaire (Baecke *et al.,* 1982) that was completed in an individual interview with each adult. Participants were asked to mention all activities that they had performed during the previous day. From this the researchers calculated PAL for each participant as follows: the PAL values of various activities performed throughout the day were determined by adding the PAL for each activity. Due to the fact that not all activities were reported in the 24-hour recall, a short physical activity frequency/week form was used for cross-referencing. This procedure was followed for all activities and added to get a total PAL per week. The total PAL/week was then divided by seven to get the average PAL/day. All results were categorised according to the classification of Frary and Johnson (2008, Table 2.2:34), adapted by the Institute of Medicine of the National Academies (2002).

Validity and reliability

To assure validity, all questions were related to the objectives of the study and questionnaires were developed based on issues discussed in the relevant literature. Because the information related to dietary intake was only to determine the intake of different foods and not nutrients, this method was

considered valid. Replication observations in dietary and physical activity assessment are impossible, and therefore true reproducibility is very difficult to determine (Gibson, 2005:129).

Data collection

Before data was collected, induction meetings for community members and other role-players were arranged in each community. The role-players included clinic staff, church leaders, community leaders and any members of the community who were interested in learning more about the project or had questions that they wanted to ask. The meetings were held in community halls or in the community clinic. At these meetings community members also provided the names of community members that could assist in informing other members of the community about the project. Separate training sessions were then arranged during which these community members were trained on how to explain the information document to community members that were eligible to participate and to obtain informed consent. These community members were also responsible for visiting eligible households on one or more occasions and advising participants on precautions to take before participation (e.g. arrive in a fasting state) and reminding participants of the day on which they were to visit the research venue. This was especially important in urban areas, where participants from different areas were scheduled to visit the research venue on different days.

Data collection took place at different research venues, including the community hall in the rural area or at the MUCPP nutrition centre in the urban area.

On days of data collection, ID documents were screened in order to make sure that the participants met the inclusion criteria for age. The research venues included stations for the collection of blood and urine samples; a food station; medical examination; as well as anthropometric measurements. All stations needed to be completed in order to be included in the study. Thereafter, questionnaires related to the following were completed: socio-demography (one per household); household food security (one per household); 24-hour recall (one for each participant); physical activity (one for each participant); and reported health (one for every participant).

Ethics

The study was approved by the Ethics Committee of Faculty of Health Sciences, University of the Free State (UFS) (ETOVS 21/07), as well as the Free State Department of Health (DoH) and local municipalities. The researchers obtained written information from all participants in their language of choice. Each household member received a participation letter in addition to the information document. This letter was used to inform them of the date they should attend the place of research to participate in the study. The procedures were also described in this document (for example, fasting on arrival). Another purpose of this document was to inform employers why the employee would not be able to attend work on that specific day. Rural and urban participants were given money for transport (R12) after they had completed all sections/stations on the data checklist. Those with urgent medical problems were referred directly after the examination. Communities were revisited by doctors after the results from laboratory investigations were available. During these follow-up appointments, participants were given their test results as well as referral letters if necessary. Patients with medical problems were referred to nearby clinics and community healthcare centres.

Statistical analysis

Descriptive statistics, including frequencies and percentages (for categorical data) and means and standards deviations (SDs) (for symmetrical numerical variables) or medians and percentiles (for skew numerical variables), were calculated. Where the "other" category was indicated by more than 5% of respondents, the given answers are indicated in the table. Differences between HIV-infected and HIV-uninfected rural groups, HIV-infected and HIV-uninfected urban groups, and HIV-infected urban respondents on ART and HIV-infected urban respondents not on ART were assessed by p-values [t-tests (for symmetrical numerical variables), Mann-Whitney tests (for skew numerical variables), chi-squared tests (for categorical variables) or Fischer's extract test (for categorical variables with sparse data)] or 95% confidence intervals (CIs) for median, mean or percentage differences. All analyses were performed by the Department of Biostatistics, University of the Free State. Logistic regression with forward selection ($p < 0.05$) was used to select significant independent factors associated with HIV status. Variables with a p-value of < 0.15 were considered for inclusion in the model. Age and gender were entered in each model as possible factors.

RESULTS

Of the 570 rural participants, 567 had HIV results and 97 (17.1%) of them were HIV-infected. Of the 426 urban participants, 424 had HIV results and 172 (40.6%) were HIV-infected. It should be noted that participants were included if all assessments or questionnaires had been completed. However, within questionnaires it was possible that not all questions had been answered, and for this reason missing values could occur (as indicated by n-values in tables).

Although not indicated in table format, the dietary diversity and physical activity information of urban participants on ART and those not on ART were also compared. Twenty five percent (43 respondents) of HIV-infected urban respondents were using ART compared to only four HIV-infected respondents (4.1%) in rural areas (results not indicated in a table). Due to this low number, HIV-infected rural participants on ART were not included in the comparison of patients using ART and those not using ART.

In Table 5.1 the median age of rural and urban respondents is described. HIV-infected rural participants were significantly younger (median age 40.5 years) than HIV-uninfected rural participants (median age 51 years) (p = 0.001). HIV-infected urban participants were also significantly younger (median age 38 years) than HIV-uninfected urban participants (median age 49 years) (p = 0.0001). The median age of HIV-infected participants in rural areas were slightly higher than in urban areas at 40.5 and 38 years respectively.

Table 5.1: Age of HIV-infected and HIV-uninfected rural and urban respondents

	HIV+						HIV-							
	N	**Median**	**25%**	**75%**	**Min**	**Max**	**N**	**Median**	**25%**	**75%**	**Min**	**Max**	**p-value[#]**	**95% CI**
Rural	92	40.5	34.0	49.5	27.0	65.0	455	40.0	51.0	57.0	25.0	65.0	0.001*	[-10; -5]
Urban	171	38.0	32.0	47.0	25.0	63.0	248	40.0	49.0	56.0	25.0	64.0	0.0001*	[-10; -6]

[#]p-value for median difference between HIV+ and HIV- participants using t-tests or Mann-Whitney, as appropriate

The median age of HIV-infected urban participants on ART was 38 years, which was very similar to those not on ART at 38.5 years.

Dietary Diversity

Dietary diversity was determined in a total of 538 (98.4%) rural and 415 (99.0%) urban adult participants.

Dietary diversity of HIV-infected and HIV-uninfected rural and urban participants

Median portion intake of the sixteen food groups is shown in Table 5.2 for rural participants and in Table 5.3 for urban participants. The food groups with the highest median intakes in both rural and urban areas were cereals, organ/flesh meat, oils and fats and sweets, while median intake of vegetables, fruit and milk and milk products were low.

Table 5.2: Portion intake of the sixteen food groups of HIV-infected and HIV-uninfected participants in rural areas

Food groups	HIV+						HIV-						
	N	25%	Median	75%	Min	Max	N	25%	Median	75%	Min	Max	p-value[#]
Cereal	89	9.0	12.0	16.0	4.0	26.0	449	9.0	12.0	16.0	0.0	36.0	0.78
White roots and tubers	89	0.0	0.0	2.0	0.0	4.0	449	0.0	0.0	2.0	0.0	6.0	0.74
Vitamin A-rich vegetables and tubers	89	0.0	0.0	0	0.0	1.0	449	0.0	0.0	0.0	0.0	3.0	0.43
Dark green leafy vegetables	89	0.0	0.0	1.0	0.0	2.0	449	0.0	0.0	1.0	0.0	4.0	0.52
Other vegetables	89	0.0	0.0	1.0	0.0	4.0	449	0.0	0.0	1.0	0.0	4.0	0.20
Vitamin A-rich fruit	89	0.0	0.0	0	0.0	1.0	449	0.0	0.0	0.0	0.0	5.0	0.83
Other fruit	89	0.0	0.0	1.0	0.0	4.0	448	0.0	0.0	0.0	0.0	4.0	0.25
Organ meat	89	0.0	0.0	0	0.0	6.0	449	0.0	0.0	0.0	0.0	12.0	0.61
Flesh meat	89	1.0	3.0	5.0	0.0	16.0	449	0.0	3.0	5.0	0.0	21.0	0.89
Eggs	89	0	0.0	0.0	0.0	6.0	449	0.0	0.0	0.0	0.0	6.0	0.002*
Fish and seafood	89	0	0.0	0.0	0.0	3.0	449	0.0	0.0	0.0	0.0	6.0	0.26
Legumes, nuts and seeds	89	0	0.0	0.0	0.0	7.0	449	0.0	0.0	0.0	0.0	6.0	0.64
Milk and milk products	89	0	1.0	2.0	0.0	6.0	449	1.0	1.0	2.0	0.0	6.0	0.08
Oils and fats	89	3.0	5.0	7.0	0.0	23.0	449	3.0	5.0	7.0	0.0	23.0	0.46
Sweets	89	4.0	6.0	9.0	0.0	26.0	449	3.0	5.0	8.0	0.0	24.0	0.01*
Spices, condiments, beverages	89	1.0	1.0	2.0	0.0	6.0	449	1.0	1.0	2.0	0.0	10.0	0.39

[#]p-value for median difference between HIV+ and HIV- rural participants using t-tests or Mann-Whitney, as appropriate

Table 5.3: Portion intake of the sixteen food groups of HIV-infected and HIV-uninfected participants in urban areas

Food groups	HIV+						HIV-						
	N	25%	Median	75%	Min	Max	N	25%	Median	75%	Min	Max	p-value[#]
Cereal	168	8.0	11.0	15.0	2.0	29.0	247	8.0	12.0	15.0	2.0	44.0	0.41
White roots and tubers	168	0.0	0.0	2.0	0.0	6.0	247	0.0	0.0	1.0	0.0	7.0	0.11
Vitamin A- rich vegetables and tubers	168	0.0	0.0	0.0	0.0	8.0	247	0.0	0.0	0.0	0.0	6.0	0.66
Dark green leafy vegetables	168	0.0	0.0	1.0	0.0	8.0	247	0.0	0.0	1.0	0.0	6.0	0.84
Other vegetables	168	0.0	0.0	2.0	0.0	6.0	247	0.0	0.0	1.0	0.0	6.0	0.09
Vitamin A-rich fruit	168	0.0	0.0	0	0.0	2.0	247	0.0	0.0	0.0	0.0	4.0	0.10
Other fruit	168	0.0	0.0	1.0	0.0	6.0	247	0.0	0.0	0.0	0.0	4.0	0.09
Organ meat	168	0.0	0.0	0.0	0.0	12.0	247	0.0	0.0	0.0	0.0	19.0	0.91
Flesh meat	168	0.0	0.0	3.0	0.0	12.0	247	0.0	0.0	3.0	0.0	21.0	0.70
Eggs	168	0.0	0.0	0.0	0.0	5.0	247	0.0	0.0	0.0	0.0	4.0	0.21
Fish and seafood	168	0.0	0.0	0.0	0.0	3.0	247	0.0	0.0	0.0	0.0	9.0	0.71
Legumes, nuts and seeds	168	0.0	0.0	0.0	0.0	12.0	247	0.0	0.0	0.0	0.0	8.0	0.11
Milk and milk products	168	0.0	1.0	2.0	0.0	4.0	247	0.0	1.0	2.0	0.0	5.0	0.41
Oils and fats	168	0.0	2.0	5.0	0.0	25.0	247	0.0	2.0	5.0	0.0	20.0	0.29
Sweets	168	2.0	3.0	5.0	0.0	14.0	247	2.0	3.0	5.0	0.0	48.0	0.75
Spices, condiments, beverages	168	1.0	1.0	2.0	0.0	6.0	247	1.0	1.0	2.0	0.0	8.0	0.68

[#]p-value for median difference between HIV+ and HIV- urban participants using t-tests or Mann-Whitney, as appropriate

Median intake of all food groups appeared to be fairly similar in the rural and urban groups. However, in the HIV-infected rural group, median intake of flesh meat (3) was higher than the intake of urban participants (0). HIV-infected rural participants also reported a higher median intake of oils and fats (5) compared to HIV-infected urban participants (2). Rural participants also consumed more sweets (6 in the HIV-infected group and 5 in the HIV-uninfected group) compared to urban participants (3). Although the median intake of eggs was naught in both HIV-infected and uninfected rural participants, significantly more HIV-infected rural participants ate eggs (19.1%) than HIV-uninfected participants (8.5%) which leads to a p-value of 0.002. When the intake of sweets in rural areas is considered, median intake was 6.0 in HIV-infected and 5.0 in HIV-uninfected rural participants (see Table 5.2), with significantly more HIV-infected rural participants that consumed sweets (97.8%) compared to HIV-uninfected rural participants (90.4%) which leads to a p-value of 0.01.

The percentage of rural and urban participants that had ingested foods from the 16 food groups during the previous day are summarised in Table 5.4.

Table 5.4: Percentage of HIV-infected and HIV-uninfected participants in rural and urban areas that ingested foods from the sixteen food groups

Food Groups	Rural					Urban				
	HIV+ (n=89)		HIV- (n=449)			HIV+ (n=168)		HIV- (n=247)		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
Cereal	89	100.0	448	99.8	1.0	168	100.0	247	100.0	
White roots and tubers	36	40.5	180	40.1	0.94	74	44.1	95	38.5	0.25
Vitamin A -rich vegetables and	6	6.7	42	9.4	0.42	15	8.9	19	7.7	0.65
tubers	29	32.6	129	28.7	0.46	59	35.1	86	34.8	0.94
Dark green leafy vegetables	27	30.3	183	40.8	0.07	76	45.2	95	38.5	0.17
Other vegetables										
Vitamin A-rich fruit	3	3.4	13	2.9	0.73	1	0.6	7	2.8	0.15
Other fruit	24	27.0	97	21.6	0.26	54	32.1	60	24.3	0.07
Organ meat	1	3.4	11	2.5	0.71	10	6.0	14	5.7	0.91
Flesh meat	67	75.3	321	71.5	0.46	83	49.4	121	49.0	0.90
Eggs	17	19.1	38	8.5	0.0025*	15	8.9	32	13.0	0.20
Fish and seafood	1	1.1	15	3.3	0.49	9	5.4	15	6.1	0.79
Legumes, nuts and seeds	7	7.9	30	6.7	0.68	38	22.6	41	16.6	0.13
Milk and milk products	62	69.7	353	78.6	0.06	107	63.7	168	68.0	0.36
Oils and fats	88	98.9	432	96.2	0.33	115	68.5	161	65.2	0.48
Sweets	87	97.8	406	90.4	0.02*	147	87.5	213	86.2	0.70
Spices, condiments, beverages	81	91.0	387	86.2	0.21	131	78.0	201	81.4	0.39

[1]p-value for difference between HIV+ and HIV- rural participants using Chi-squared or Fisher's exact test, as appropriate

[2]p-value for difference between HIV+ and HIV- urban participants using Chi-squared or Fisher's exact test, as appropriate

Almost all participants had eaten foods from the cereal group during the previous day (included corn, maize, rice, wheat, sorghum, millet or any other grains or foods from these). In rural areas there were no large differences in the percentage of HIV-infected participants and HIV-uninfected participants that ate cereal, white roots and tubers, vitamin A-rich vegetables and tubers (such as pumpkin, carrot, squash, or sweet potato that are orange inside, as well as other locally available vitamin A-rich vegetables, i.e. red sweet pepper), and dark green leafy vegetable intake. The same was seen in urban areas.

The percentage of participants that had eaten vegetables during the previous day was generally low. Intake of vitamin A-rich vegetables and tubers ranged from 6.7% of rural HIV-infected participants to 9.4% of rural HIV-uninfected participants. The percentage of HIV-infected rural respondents that

consumed other vegetables (such as tomato, onion, eggplant and other locally available vegetables) (30.3%) was lower than the percentage of HIV-uninfected rural respondents (40.8%), but the difference was not statistically significant (p = 0.07). On the other hand, HIV-infected urban respondents consumed slightly more other vegetables (45.2%) during the previous day than HIV-uninfected urban respondents (38.5%). The same was found for intake of other fruits, such as wild fruits and 100% fruit juice made from these, in urban areas where HIV-infected respondents consumed more (32.1%) than those not infected (24.3%), but the difference was not statistically significant (p = 0.07).

A significantly larger percentage of HIV-infected rural respondents consumed eggs (eggs from chicken, duck, guinea fowls or any other egg) (19.1%) than HIV-uninfected rural respondents (8.5%), (p = 0.0025). The percentage of rural respondents that ate legumes, nuts and seeds (such as dried beans, dried peas, lentils, nuts, seeds and foods made from these) was low and ranged from 6.7% for HIV-uninfected respondents to 7.9% for HIV-infected respondents. A larger percentage of HIV-uninfected participants living in rural areas consumed milk and milk products (including milk, cheese, yoghurt or other milk products) (78.6%) than the HIV-infected counterparts (69.7%), but the difference was not statistically significant.

Almost all rural respondents consumed oils and fats (including oils, fats or butter added to food or used for cooking) during the previous day. In both groups the percentage of respondents that ate sweets (such as sugar, honey, sweetened soda or sweetened juice drinks, sugary foods such as chocolates, candies, cookies and cakes) was very high, with 97.8% of HIV-infected rural participants consuming significantly more sweets compared to 90.4% of HIV-uninfected rural participants (p = 0.02).

Compared to urban participants, a smaller percentage of HIV-infected rural participants consumed other vegetables [30.3% rural versus (vs.) 45.2% urban] and other fruit (27.0% rural vs. 32.1% urban) compared to HIV-infected urban participants. However, a higher percentage of HIV-infected rural respondents consumed flesh meat (including beef, pork, lamb, goat, rabbit, game, chicken, duck,

other birds, insects) (75.3% rural vs. 49.4% urban), as well as eggs (19.1% rural vs. 8.9% urban) when compared to HIV-infected urban respondents. A larger percentage of HIV-infected urban participants consumed legumes, nuts and seeds (22.6%) than the HIV-infected rural group (7.9%). As expected, intake from the oils and fats, sweets, as well as spices, condiments and beverages group was also reported by the majority of participants.

A DDS was calculated by counting the number of food groups (from a possible 12 groups). A score ≤ 3 was considered a low DDS, 4 to 5 medium and ≥ 6 was considered a high DDS (FAO, 2003). Table 5.5 shows the DDSs of participants in rural and urban communities.

Table 5.5: Dietary Diversity Score (DDS) of HIV-infected and HIV-uninfected participants in rural and urban areas

Dietary Diversity Score	Rural					Urban				
	HIV+ (n=89)		HIV- (n=449)			HIV+ (n=168)		HIV- (n=247)		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
Low DDS ($\leq$ 3 food groups)	1	1.1	8	1.8		14	8.3	16	6.5	
Median DDS (4 and 5 food groups)	15	16.9	71	15.8	0.88	34	20.2	67	27.1	0.24
High DDS ($\geq$ 6 food groups)	73	82.0	370	82.4		120	71.4	164	66.4	

[1]p-value for difference between HIV+ and HIV- rural participants using Chi-squared or Fisher's exact test, as appropriate

[2]p-value for difference between HIV+ and HIV- urban participants using Chi-squared or Fisher's exact test, as appropriate

One out of five participants had low to medium DDSs, but no significant differences in the DDSs of HIV-infected and HIV-uninfected participants occurred in rural and urban areas. A slightly higher percentage of HIV-infected urban participants had a low DDS (8.3%) compared to HIV-uninfected urban participants (6.5%). Differences in DDS in HIV-infected and HIV-uninfected groups (in both rural and urban areas), were, however not statistically significant. A higher percentage of HIV-infected urban participants had a low DDS (8.3%) compared to HIV-infected rural participants (1.1%).

Dietary diversity of HIV-infected urban participants on ART and not on ART

A total of 43 HIV-infected urban respondents on ART and 125 HIV-infected urban respondents not on ART reported on intake of sixteen food groups (not indicated in a table).

The only difference in the median intake of foods between participants on ART and not on ART was related to egg consumption with statistically more participants on ART having eaten eggs (18.6%) compared to those not on ART (5.6%) with a p-value of 0.007 for median intake (0) and p = 0.02 for percentage difference.

A similar percentage of respondents taking ART compared to respondents not on ART had a low (9.3% vs. 8.0%), medium (16.3% vs. 21.6%) and high (74.4% vs. 70.4%) DDS.

Physical Activity

A total number of 108 men and 416 female rural participants and 94 male and 314 female urban participants reported on PAL. Results obtained by means of a 24-hour physical activity recall questionnaire are shown in the following Tables.

Median PAL for men living in rural and urban areas are summarised in Table 5.6 and for women living in rural and urban areas in Table 5.7.

Table 5.6: Physical Activity Level (PAL) of HIV-infected and HIV-uninfected men in rural and urban areas

	HIV+ (N = 59)						HIV- (N = 143)						
	N	**Median**	**25%**	**75%**	**Min**	**Max**	**N**	**Median**	**25%**	**75%**	**Min**	**Max**	**p-value[#]**
Rural	24	1.7	1.4	2.1	1.2	2.9	84	1.8	1.5	2.2	1.2	4.1	0.65
Urban	35	1.5	1.4	1.7	1.1	2.6	59	1.5	1.3	1.7	1.1	2.4	0.54

[#]p-value for median difference between HIV+ and HIV- male participants using t-tests or Mann-Whitney, as appropriate

The median PAL of HIV-infected rural men was lower at 1.7 (active) compared to HIV-uninfected rural men at 1.8 (active). In urban areas, the median PAL of HIV-infected men was the same as HIV-uninfected men (median 1.5, low active).

Table 5.7: Physical Activity Level (PAL) of HIV-infected and HIV-uninfected women in rural and urban areas

	HIV+ (N = 192)						HIV- (N = 538)						
	N	**Median**	**25%**	**75%**	**Min**	**Max**	**N**	**Median**	**25%**	**75%**	**Min**	**Max**	**p-value[#]**
Rural	62	1.7	1.5	1.9	1.2	3.0	354	1.8	1.6	2.1	1.1	4.5	0.02*
Urban	130	1.5	1.4	1.6	0.2	2.2	184	1.5	1.5	1.7	0.1	2.0	0.18

[#]p-value for difference between HIV+ and HIV- female participants using t-tests or Mann-Whitney, as appropriate

In rural areas, the median PAL of HIV-infected women were statistically lower at 1.7 compared to 1.8 in HIV-uninfected women (p = 0.02). In urban areas, the median PAL of HIV-infected women was the same as that of HIV-uninfected women (median 1.5, low active).

A total number of 35 male and 130 female HIV-infected urban respondents on ART (96.5%) reported on PAL (not tabulated). In urban areas, the median PAL of HIV-infected men on ART was slightly higher at 1.6 (active) than HIV-infected men not on ART (median 1.5, low active), but the difference was not statistically significant different (p = 0.18). As for women, the median PAL of HIV-infected urban women on ART was slightly higher at 1.6 (active) than HIV-infected urban women not on ART (median 1.5, low active), but not significantly so.

Categories of physical activity for HIV-infected and HIV-uninfected rural and urban respondents

Physical activity levels were categorised as sedentary; low active; active and very active. Table 5.8 shows the PAL categories for HIV-infected and HIV-uninfected participants in rural and urban areas

A slightly higher percentage of rural HIV-uninfected men were sedentary (17.9%) compared to HIV-infected men (12.5%). The opposite was seen in women, where statistically significantly more HIV-infected rural women were sedentary (14.5%) compared to HIV-uninfected rural women (5.1%) (p = 0.01). Significantly more HIV-uninfected rural women were very active (42.1%) compared to 22.6% HIV-infected women (p = 0.003). A higher percentage of HIV-uninfected men living in rural areas were very active (42.9%) than HIV-infected men living in rural areas (29.2%), but the differences was not statistically significant.

Table 5.8: Categories of physical activity level for HIV-infected and HIV-uninfected participants in rural and urban areas

Variable	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
PAL categories men										
Rural: HIV+=24, HIV-=84; Urban: HIV+=35, HIV-=59										
Sedentary (1.0-1.39)	3	12.5	15	17.9	0.75	11	31.4	22	37.3	0.56
Low active (1.4-1.59)	7	29.2	14	16.7	0.24	11	31.4	18	30.5	0.92
Active (1.6-1.89)	7	29.2	19	22.6	0.50	9	25.7	12	20.3	0.54
Very active (1.9-2.5)	7	29.2	36	42.9	0.22	4	11.4	7	11.9	1.0
PAL categories women										
Rural: HIV+=62, HIV-=354; Urban: HIV+=130, HIV-=184										
Sedentary (1.0-1.39)	9	14.5	18	5.1	0.01*	27	20.8	28	15.2	0.20
Low active (1.4-1.59)	11	17.7	61	17.2	0.92	64	49.2	89	48.4	0.88
Active (1.6-1.89)	28	45.2	126	35.6	0.15	34	26.2	62	33.7	0.15
Very active (1.9-2.5)	14	22.6	149	42.1	0.003*	5	3.9	5	2.7	0.74

[1]p-value for difference between HIV+ and HIV- rural participants using Chi-squared or Fisher's exact test, as appropriate

[2]p-value for difference between HIV+ and HIV- urban participants using Chi-squared or Fisher's exact test, as appropriate

Dietary diversity and physical activity factors associated with HIV status in logistic regression model

In addition to descriptive comparisons between HIV-infected and HIV-uninfected participants, logistic regression was used to identify significant dietary diversity and physical activity factors associated with HIV status.

Dietary diversity and physical activity factors associated with HIV status in rural participants

The following dietary diversity variables were considered for inclusion:

Other vegetables, eggs, milk and milk products (all as yes vs. none). Age, eggs and sweets were selected in the model. When considering physical activity (sedentary, low active, active, very active) age, gender and physical activity were selected in the model. When considering these selected significant dietary and physical activity variables together for inclusion in the model, age, physical activity, eggs and sweets were selected as significant with odds ratios as indicated in Table 5.9.

Table 5.9: Diet diversity and physical activity factors associated with HIV status (rural)

Variable		Odds ratio (95% CI)	p-value
Age		0.93 (0.90; 0.95)	<0.0001
Eggs	none vs. some	0.41 (0.20; 0.82)	0.0112
Sweets	none vs. some	0.19 (0.04; 0.85)	0. 0298
Physical activity	sedentary vs. very active	3.18 (1.31; 7.70)	0.0100
	low active vs. very active	2.27 (1.08; 4.77)	
	active vs. very active	2.44 (1.31; 4.55)	

In this rural sample, for every year that age increased, the odds of having HIV decreased (by 7%). As far as dietary intake in this sample was concerned, HIV-infection was negatively associated with a person consuming no eggs (odds ratio 0.41) and consuming no sweets (odds ratio 0.19). On the other hand, HIV-infection was positively associated with a person being sedentary vs. very active (odds ratio 3.18), low active vs. very active (odds ratio 2.27) and active vs. very active (odds ratio 2.44).

Dietary diversity and physical activity factors associated with HIV status in urban participants

The following diet diversity variables were considered for inclusion:

Other fruit and legumes/nuts/needs but neither of these was selected into the model. When considering physical activity, age and gender, only age was selected into the model. No significant dietary diversity or physical activity factors were identified in the urban sample.

DISCUSSION

Dietary Diversity

Data from the present study provided a profile of dietary diversity patterns in a South African HIV-infected and HIV-uninfected sample from the Free State. Higher dietary diversity has widely been associated with higher socio-economic status (Slattery *et al.*, 1997). This is because people with a high income may have the economic ability to purchase different types of foods from different food groups whereas those with low income often choose more cost-effective available foods, and this limits diet diversification among the poor (Friis and Michaelsen, 1998).

The National Agriculture Marketing Council (2012) compared April 2011 to April 2012 and found the significant price inflation (10% or more) experienced for important products such as maize meal, bread, cabbage, tomatoes, chicken milk and margarine, will have a negative impact on household food security in South Africa. The present study showed that daily meals typically consisted of starches, e.g. maize meal porridge and bread. Other studies done in South Africa (Labadarios *et al.,* 2011; Oldewage-Theron and Kruger, 2011) have also reported that starches form the basis of the diet. But, according to the National Agriculture Marketing Council (2012), inflation will affect the affordability of important staple foods as well as food items (such as vegetables, fruit, meat and milk and milk products), that make a major contribution to dietary diversity.

In a study undertaken in the Vaal-Triangle, it was concluded that limited food access and food variety in poor households resulted in inadequate nutrient intakes (low nutrient adequacy ratios), confirmed by poor dietary diversity (food variety score and food group diversity score) (Oldewage-Theron and Kruger, 2011). In the current study, a large percentage of respondents did not eat a variety of foods, especially those that are considered healthy, such as dairy and fruit and vegetables. DDSs included foods from fat and oils; sweets; and spices, condiments, and beverages; that tended to improve DDSs, without necessarily depicting healthy food choices.

Of particular concern in the present study were the low intake and diversity of vegetables and fruits in rural and urban groups. It has been documented that the poor micronutrient intake of older black South Africans can be ascribed to the small number of portions consumed from the vitamin C- or carotene-rich vegetable group (Charlton *et al.*, 2001). In the current study less than 10% of all groups ate vitamin A-rich vegetable and tubers. A study in Kenya by Onyango *et al.* (2011) assessed nutrient intake of HIV-infected patients and found that only 23.8% of HIV-infected adults consumed vegetables, which was slightly lower to the results of the present study (30%). The results suggest that less than 40% of HIV-infected patients consumed vegetables daily and this may be due to the vegetables being available and affordable compared to other food like animal proteins, which might also be the case in the present study. In the study conducted in the Vaal Triangle, no fruit appeared

on the top twenty most frequently consumed food items of female caregivers (Oldewage-Theron and Kruger, 2011), and a poor variety in food intake in that community was confirmed.

Although most respondents in the rural groups reported intake of flesh meat, less than 50% of urban respondents reported eating flesh meat during the previous day. Few people consumed noticeable amounts of organ meat. Results from the Transition in Health during Urbanisation of South Africans (THUSA) study performed in the North West province in South Africa showed increases in total and animal-derived protein were sustained in subjects with the highest incomes. The baseline survey results showed that poverty was prevalent in our sample (reported in Chapter 4) and may be one of the reasons for the low intake of flesh meat. A study on HIV-infected participants in the Free State province, South Africa, by Dannhauser *et al.* (1999), reported that the majority of participants in that study had a protein intake of less than 67% of the recommended daily allowance (RDA).

Results from the logistic regression confirmed that an intake of eggs was positively associated with HIV-infection in the rural sample. This finding is difficult to explain, but may be related to the cultural belief that consumption of eggs is unacceptable in some groups (which may in turn be associated with other lifestyle choices).

In the present study oils and fats, sweets, as well as spices, condiments and beverages were consumed by the majority of HIV-infected and HIV-uninfected rural and urban respondents. Results from the logistic regression confirmed that intake of sweets was also positively associated with HIV-infection in the rural sample. It may be that people that follow a more healthy diet are also more likely to follow an overall healthy lifestyle (which may also be related to sexual behaviour).

In the study done in Kenya, Onyango *et al.* (2011) fats and oils were one of the most commonly consumed food groups. This concurs with the present study, especially in rural areas, where almost all participants consumed fats and oils during the previous day. Although these foods contribute to dietary diversity, they are not considered healthy choices.

Oketch *et al.* (2011) conducted a household-based cross-sectional study of HIV-infected adults from KwaZulu-Natal. In this study DDS was categorised as low (<4), medium (4-5) and high (>5). They found that sugar and beverages were consumed by more than 50% of the participants in the medium and high DDS category. In addition, vegetables and meat were consumed by more than 50% of participants in the high DDS. Similarly, only about 50% of urban participants in the present study ate meat during the previous day, while more than 70% rural participants consumed meat. In the current study a high percentage of all participants (more than 85.0%) consumed sweets during the previous day, but only about a third consumed vegetables.

In terms of the recommendations of the WHO/FAO (2003), the following trends in South Africa are not desirable: poor intake of fruit and vegetables; high fat intake; low milk intake; overall increase in energy intake and low fibre intake (due to low intake of fruit, vegetables and legumes intake) (Steyn, 2006). The current study confirmed most of these trends in HIV-infected and uninfected participants in rural and urban areas.

Physical Activity

In the present study, median PALs of HIV-infected rural women were statistically significantly lower than HIV-uninfected rural women. In urban communities, HIV-infected women also tended to follow a sedentary or low active lifestyle compared to HIV-uninfected counterparts. As with many infections, higher resting metabolic rate is an important factor for energy imbalance in HIV/AIDS (WHO, 2005), however patients with AIDS have been shown to have much lower energy expenditure than HIV-uninfected people (Salas-Salvadó and García-Lorda, 2001). This is because activity levels of patient levels tend to decline as they become more and more unwell (Hsu *et al.*, 2005), as also seen in this study amongst the female participants. Results from the logistic regression confirmed that HIV-infection was positively associated with lower physical activity, which is an outcome of HIV-disease.

Several studies have shown the benefits of graded exercise schedules on body composition and well-being, but patients with severe HIV/AIDS associated wasting often present with fatigue and are unlikely to be able to maintain high levels of physical activity (Hsu *et al.*, 2005). In this study more

than 30% of HIV-infected men living in urban areas were sedentary. Total daily energy expenditure decreases among HIV-infected men during rapid weight loss, mainly because physical activity is reduced (Macallan *et al.*, 1995; Sheehan and Macallan, 2000).

We acknowledge that there is a certain degree of bias regarding the age of rural volunteers in the study. Older and unemployed individuals were more likely to participate than young professionals. Furthermore, more women than men participated in the study probably due to men being labourers and formally employed and therefore not available for interviews conducted during the day. It is also possible that ill persons may have been more likely to participate in the study where medical examinations were conducted due to limited health services, especially in rural areas. Due to these reasons, the authors acknowledge that the study group is probably not representative of the general population.

CONCLUSIONS

One out of five participants had low to medium DDSs, but no significant differences in the DDSs of HIV-infected and HIV-uninfected participants occurred in rural and urban areas. Intake of no eggs and no sweets was negatively associated with HIV-infection, while lower levels of physical activity were positively associated with HIV-infection, probably because lower levels of physical activity are an outcome of HIV-infection. In rural areas, HIV impacts on quality of life, as evidenced by reduced levels of physical activity.

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CHAPTER 6

Anthropometric Status of HIV-infected and HIV-uninfected Rural and Urban Communities in the Free State, South Africa

ABSTRACT

Weight loss and wasting are strong predictors of poor prognosis in HIV-infection. The objective of this study was to determine significant independent anthropometric factors associated with HIV status in rural and urban communities in the Assuring Health for All (AHA) study which was undertaken in rural Trompsburg, Philippolis and Springfontein (2007) and urban Mangaung (2009).

Adults between 25-64 years were eligible to participate. Of the 567 rural participants, 97 (17.1%) were HIV-infected. Of the 424 urban participants, 172 (40.6%) were HIV-infected. Logistic regression with forward selection ($p < 0.05$) was used to select significant independent anthropometric factors associated with HIV status. Variables with a p-value of < 0.15 were considered for inclusion in the model.

In both the rural and urban samples, the odds of having HIV-infection decreased for every year that age increased (by 7.0% per year). In rural areas, HIV-infection was positively associated with a low versus high body fat percentage (odds ratio 15.56, 95% CI 0.80; 303.81); an acceptable low versus high body fat percentage (odds ratio 4.21, 95% CI 2.13; 8.31); and acceptable high versus high body fat percentage (odds ratio 1.85, 95% CI 0.81; 4.22). In the urban sample, HIV-infection was negatively associated with male gender (odds ratio 0.29, 95% CI 0.15; 0.53). On the other hand, HIV-infection was positively associated with a low or acceptable low versus high body fat percentage (odds ratio 9.18, 95% CI 4.89; 17.23) and acceptable high versus high body fat percentage (odds ratio 2.73, 95% CI 1.46; 5.12), probably due to the fact that a decrease in body fat percentage is an outcome of HIV-infection.

INTRODUCTION

Nutritional status plays an important role in maintaining a healthy immune system and delaying the progression of Human Immunodeficiency Virus (HIV) to Acquired Immune Deficiency Syndrome (AIDS) (Dong and Imai, 2012:864). Nutritional status is a major factor in survival, and, even in the absence of disease, starvation can lead to death when a person reaches two thirds of ideal body weight for height (Fenton and Silverman, 2008:1008). When a person is infected with HIV, weight loss and loss of

body cell mass become strong predictors of poor prognosis [Academy of Science of South Africa (ASSAf), 2007:141].

Wasting syndrome and other forms of malnutrition have been identified as one of the first line complications of HIV/AIDS (Salomon *et al.*, 2002). Wasting implies unintentional weight loss and loss of lean body mass, which have been strongly associated with an increased risk of disease progression, loss of muscle protein mass, impairment of strength and functional status and mortality (Dong and Imai, 2012:878; Grinspoon and Mulligan, 2003).

Wasting is usually followed by loss of appetite, repeated infections and changes in body composition, including changes in lean body mass and cell mass (Babameto and Kotler, 1997). Overall anorexia leading to a reduced nutrient intake is the most important cause of weight loss in HIV-infected patients [Macallan *et al.*, 1995; World Health Organisation (WHO), 2005]. Increased resting energy expenditure, accelerated protein turnover, decreased energy intake, diarrhoea and malabsorption, and acute weight loss are then often associated with secondary infections and mortality risk (ASSAf, 2007:174; Anabwani and Navario, 2005).

As mentioned, unintentional weight loss in HIV-infection has been associated with mortality, but a more careful review of overweight and obesity in HIV-infected individuals is also important (Dong and Imai, 2012:878). Both obesity and undernutrition are common in South Africa and can impact on the health of HIV-infected people (Puoane *et al.*, 2002; Anabwani and Navario, 2005; Salomon *et al.*, 2002). The malnutrition pattern in the general adult population in South Africa is predominately one of overnutrition (Puoane *et al.,* 2002; Steyn *et al.*, 2006; Vorster *et al.*, 2007). The South African Demographic and Health Survey (SADHS) (2003) determined that in 1998, 56.6% of women and 29.2% of men were overweight or obese and 42.2% of women and 9.2% of men were abdominally obese, which is associated with undesirable health consequences, such as increased risk for developing diabetes mellitus and hypertension (SADHS, 2003; ASSAf, 2007:19).

Weight gain and changes in body shape are common among those on antiretroviral therapy (ART) (Brown *et al.*, 2006), but, in the age of ART, continuously gaining body weight is no longer considered to be a protective defense against HIV-related wasting and progression to HIV (Dong and Imai, 2012:878). Excessive weight gain in HIV-infected persons on ART, is a risk factor for chronic noncommunicable diseases including diabetes mellitus, hypertension, cardiovascular disease and dyslipidaemia (Brown *et al.*, 2006; Bradshaw *et al.*, 2003; Hendricks *et al.,* 2006) and central obesity is a stronger predictor of metabolic syndrome than body mass index (BMI) (Shen *et al.*, 2006).

While biological markers are now being used in clinical practice, the performance of clinical indicators of nutritional status in predicting HIV-disease progression still needs further study as they are more often and more easily available (Malvey *et al.,* 2001). Body mass is likely to contribute to the functional impairments shown by patients who are HIV-infected (Bauer *et al.,* 2011). It is a factor that varies noticeably with both the severity of HIV-disease and its treatment (Amorosa *et al.,* 2005). BMI and waist circumference (WC) measurements are simple, quick to perform, reliable (after training in the technique) and appropriate for evaluating nutritional status of subjects in resource-poor settings (Hurley *et al.*, 2011). BMI refers to current weight in kilograms (kg) divided by height in meters square (m^2). Low BMI (< 18.5 kg/m^2) is a strong predictor of mortality in HIV-infected patients starting ART, with higher mortality in persons who are both food insecure and underweight versus (vs.) underweight but food secure (Weiser *et al.,* 2009).

Measures such as WC can complement BMI estimates (WHO, 2004). WC provides a simple and practical anthropometric measure for assessing central adiposity (Lean *et al.,* 1995; Han *et al.,* 1997). In fact, an increasing number of studies are reporting strong associations between WC, visceral adipose tissue, and obesity-related health risks (Hill *et al.*, 1999; Sidney *et al.*, 1999). WC provides a crude but effective measure of visceral fat in most subjects (Alberti *et al.*, 2005). The increasing recognition of a strong link between central adiposity and metabolic disturbances led Shen *et al.* (2006) to test whether WC is more highly associated with metabolic syndrome than percent fat and other related anthropometric measures such as BMI. They found that WC had the strongest association with health risk indicators, followed by BMI. Although percent fat is a useful measure of

overall adiposity, health risks are best represented by the measure of WC (Shen *et al.,* 2006). When WC is used as an independent predictor of risk, a WC of > 94 cm in men and > 80 cm in women is considered a risk (Alberti *et al.*, 2005). Mid-upper-arm-circumference (MUAC) measurements are especially useful for screening for protein energy malnutrition (PEM) [National AIDS and STI Control Programme (NASCOP), 2007:27] and therefore a measure of poor nutritional status. The indicator is useful to measure acute adult undernutrition to determine prevalence of malnutrition at population level (NASCOP, 2007:31).

Measurement of skinfold thickness measured at several standardised points on the body to determine the subcutaneous fat layer thickness (Bruner, 2001), can be converted to an estimated body fat percentage using an equation. Percentage body fat is a good indicator of muscle mass and wasting and also often considered the reference for establishing the degree of adipose tissue buildup and the risk of excess adiposity (Shen *et al.,* 2006).

In wasted patients, a relationship has been established between survival and the extent of the body cell mass depletion (Salas-Salvadó and García-Lorda, 2001). In addition, measures of anthropometry are also useful to determine risk for chronic disease in patients on ART. Therefore, the aim of this study was to determine anthropometric factors associated with HIV status in rural and urban communities living in the Free State province.

OBJECTIVES

This study formed part of the baseline phase of the Assuring Health for All in the Free State (AHA-FS) study which aims to determine how living in rural and urban communities can influence lifestyle and health. The aim of this sub-study was to determine anthropometric factors associated with HIV status in the southern Free State.

METHODOLOGY

The rural study was performed in 2007 in three rural Free State towns, namely Trompsburg, Philippolis and Springfontein and the urban study in 2009 in Mangaung, adopting a cross-sectional study.

Target population and sampling

In rural areas all households in black and coloured townships were eligible to participate. In urban Mangaung the number of plots in the Mangaung University Community Partnerships Programme (MUCPP) service area was counted on a municipal map and included Buffer, Freedom Square, Kagisanong, Chris Hani, Namibia and Turflaagte. An estimate was made of additional squatter households in open areas. A stratified proportional cluster sample was selected, stratified by area and formal plot/squatter households in open areas. Using randomly selected X and Y coordinates, one hundred starting points were selected in this way. From each point five adjacent starting households were approached for inclusion in the study.

Every adult member of households in these black and coloured communities, who gave informed consent and was between the age of 25-64 years, was eligible to participate.

Pilot study

Pilot studies were undertaken in five persons in each area, similar to the target group before the main survey in order to determine whether questions included in the questionnaire could be easily understood and to determine the amount of time needed to complete the questionnaires. All questionnaires and anthropometric measurements were piloted. Minor changes (mostly technical editing) were made to questionnaires after the pilot study.

Variables and operational definitions

Anthropometric variables included height, weight, WC, MUAC and four skinfold thickness measurements (including triceps, biceps, supra-iliac and subscapular).

Adults were categorised as underweight (BMI less than 18.5 kg/m²); normal weight (BMI 18.5 kg/m² or over, but less than 25 kg/m²); overweight (BMI 25 kg/m² or over but less than 30 kg/m²); or obese (BMI 30 kg/m² or over) (Gibson, 2005:322). A WC equal to or larger than 94 cm for men and 80 cm for women was considered as at risk WC (Gibson, 2005:323). MUAC measurements were categorised below the 15th percentile, between the 15th and 75th percentile and above the 75th percentile (Lee and Nieman, 2007:176). A body fat percentage equal to or less than 5% for men and 8% for women was considered as unhealthy range (too little body fat); a body fat percentage of 6-15% for men and 9-23% for women as acceptable lower-end range; a body fat percentage of 16-24% for men and 24-31% for women as acceptable upper end range; and a body fat percentage equal to or larger than 25% for men and 32% for women as unhealthy (too much body fat) (Lee and Nieman, 1999).

Techniques

All measurements were taken with respondents wearing an examination gown, without shoes. Anthropometric measurements were determined by trained dietetics students, using standardised methods (Lee and Nieman, 2007:170-201).

Height was measured using a stadiometer to the nearest 0.5 cm and weight was determined with a digital scale to the nearest 0.1 kg (Lee and Nieman, 2007:171-173).

WC was measured with a flexible, nonelastic tape measure to the nearest 0.5 cm (Lee and Nieman, 2007:188-189). WC was measured in a horizontal position, midway between the inferior margin of the ribs and the superior border of the iliac crest (Gibson, 2005:323).

MUAC was measured at the middle point, halfway between the acromion and the olecranon. Triceps skinfold thickness was measured 1.0 cm above the midpoint of the triceps and biceps skinfold thickness was measured 1.0 cm above the midpoint of the bicep. Subscapular skinfold thickness was determined by taking a 45° angle measurement below and laterally to the angle of the shoulder blade. Suprailiac skinfold thickness was measured by taking a 45° angle measurement at the mid axillary line superior to the iliac crest. All measurements were recorded directly after the caliper

reading stabilised. The sum of the four skinfolds was used to determine body fat percentage (Durnin and Wormersley, 1974).

Validity and reliability

In order to ensure validity and reliability of results, all anthropometric measurements were determined in accordance with accepted published recommendations (Lee and Nieman, 2007:170-201). Scales were at the zero point before each measurement and the scale was calibrated with a 5kg known weight after every twentieth participant measured by the students. To ensure reliability, researchers used the standardised techniques recommended by Lee and Nieman (2007:170-201). Reliability of skinfold measurement was assured by correctly marking the landmarks, placing the calipers correctly (not too deep and not too superficial) and not maintaining the pinch too long (Gibson, 2005:236).

Data collection

Before data was collected, induction meetings for community members and other role-players were arranged in each community. The role-players included clinic staff, church leaders, community leaders and any members of the community who were interested in learning more about the project or had questions that they wanted to ask. The meetings were held in community halls or in the community clinic. At these meetings community members also provided the names of community members that could assist in informing other members of the community about the project. Separate training sessions were then arranged during which these community members were trained on how to explain the information document to community members that were eligible to participate and to obtain informed consent. These community members were also responsible for visiting eligible households on one or more occasions and advising participants on precautions to take before participation (e.g. arrive in a fasting state) and reminding participants of the day on which they were to visit the research venue. This was especially important in urban areas, where participants from different areas were scheduled to visit the research venue on different days.

Data collection took place at different research venues, including the community hall in the rural area or at the MUCPP nutrition centre in the urban area.

On days of data collection, ID documents were screened in order to make sure that the participants met the inclusion criteria for age. The research venues included stations for the collection of blood and urine samples; a food station; medical examination; as well as anthropometric measurements. All stations needed to be completed in order to be included in the study. Thereafter, questionnaires related to the following were completed: socio-demography (one per household); household food security (one per household); 24 hour-recall (one for each participant); physical activity (one for each participant); and reported health (one for every participant).

Ethics

The study was approved by the Ethics Committee of Faculty of Health Sciences, University of the Free State (UFS) (ETOVS 21/07), as well as the Free State Department of Health (DoH) and local municipalities. The researchers obtained written information from all participants in their language of choice. Each household member received a participation letter in addition to the information document. This letter was used to inform them of the date they should attend the place of research to participate in the study. The procedures were also described in this document (for example, fasting on arrival). Another purpose of this document was to inform employers why the employee would not be able to attend work on that specific day. Rural and urban participants were given money for transport (R12) after they had completed all sections/stations on the data checklist. Those with urgent medical problems were referred directly after the examination. Communities were revisited by doctors after the results from laboratory investigations were available. During these follow-up appointments, participants were given their test results as well as referral letters if necessary. Patients with medical problems were referred to nearby clinics and community healthcare centres.

Statistical analysis

Descriptive statistics, including frequencies and percentages (for categorical data) and means and standards deviations (SDs) (for symmetrical numerical variables) or medians and percentiles (for skew

numerical variables), were calculated. Where the "other" category was indicated by more than 5% of respondents, the given answers are indicated in the table. Differences between HIV-infected and HIV-uninfected rural groups, HIV-infected and HIV-uninfected urban groups, and HIV-infected urban respondents on ART and HIV-infected urban respondents not on ART were assessed by p-values [t-tests (for symmetrical numerical variables), Mann-Whitney tests (for skew numerical variables), chi-squared tests (for categorical variables) or Fischer's extract test (for categorical variables with sparse data)] or 95% confidence intervals (CIs) for median, mean or percentage differences. All analyses were performed by the Department of Biostatistics, University of the Free State. Logistic regression with forward selection ($p < 0.05$) was used to select significant independent factors associated with HIV status. Variables with a p-value of < 0.15 were considered for inclusion in the model. Age and gender were entered in each model as possible factors.

RESULTS

Of the 570 rural participants, 567 had HIV results. Of these, 97 (17.1%) were HIV-infected. Of the 426 urban participants, 424 had HIV results. Of these, 172 (40.6%) were HIV-infected.

It should be noted that participants were included if all assessments or questionnaires had been completed. However, within questionnaires it was possible that not all questions had been answered, and for this reason missing values could occur (as indicated by n-values in tables).

Although not indicated in table format, the anthropometric results of urban participants on ART and those not on ART were also compared. Twenty five percent (43 respondents) of HIV-infected urban respondents were using ART compared to only four HIV-infected respondents (4.1%) in rural areas (not tabulated). Due to this low number, HIV-infected rural participants on ART were not included in the comparison of patients using ART and those not using ART.

In Table 6.1 the median age of rural and urban respondents is described. HIV-infected rural participants were significantly younger (median age 40.5 years) than HIV-uninfected rural participants (median age 51 years) (p = 0.001). HIV-infected urban participants were also significantly younger (median age 38 years) than HIV-uninfected urban participants (median age 49 years) (p = 0.0001). The median age of HIV-infected participants in rural areas were slightly higher than in urban areas at 40.5 and 38 years respectively.

Table 6.1: Age of HIV-infected and HIV-uninfected rural and urban respondents

	HIV+						HIV-							
	N	**Median**	**25%**	**75%**	**Min**	**Max**	**N**	**Median**	**25%**	**75%**	**Min**	**Max**	**p-value[#]**	**95% CI**
Rural	92	40.5	34.0	49.5	27.0	65.0	455	40.0	51.0	57.0	25.0	65.0	0.001*	[-10; -5]
Urban	171	38.0	32.0	47.0	25.0	63.0	248	40.0	49.0	56.0	25.0	64.0	0.0001*	[-10; -6]

[#]p-value for median difference between HIV+ and HIV- participants using t-tests or Mann-Whitney, as appropriate

The median age of HIV-infected urban participants on ART was 38 years, which was very similar to those not on ART at 38.5 years.

Anthropometric variables in HIV-infected and HIV-uninfected participants in rural and urban areas

Table 6.2 and Table 6.3 illustrate the median anthropometric information of HIV-infected and HIV-uninfected rural and urban men.

In rural areas, the median BMI of HIV-uninfected men fell into the normal weight category at 21.0 kg/m² compared to 18.7 kg/m² of the HIV-infected men, indicating a median difference of 2.3 kg/m², which was statistically significant (p = 0.02). HIV-infected rural men also had significantly lower median MUAC (24.5 cm vs. 27.0 cm, p = 0.02) and lower median body fat percentage (7.4% vs. 9.2%, p = 0.03) compared to HIV-uninfected rural men.

Table 6.2: Anthropometric information of HIV-infected and HIV-uninfected males in rural communities

Variable	Rural												
	HIV+						HIV-						
	N	Median	Mean	SD	Min	Max	N	Median	Mean	SD	Min	Max	p-value[#]
BMI (kg/m²)	25	18.7	19.6	4.5	15.5	33.6	85	21.0	21.84	5.27	11.8	41.4	0.02*
WC (cm)	24	77.0	77.8	10.3	61.2	106.0	83	79.0	81.42	14.46	48.5	130.0	0.31
MUAC (cm)	25	24.5	25.2	4.3	17.3	36.5	85	27.0	27.58	4.9	18.0	45.5	0.02*
Triceps (cm)	25	7.0	9.5	7.2	2.0	31.0	85	10.0	12.3	8.5	2.0	39.0	0.067
Body fat percentage (%)	24	7.4	9.1	4.4	4.9	20.2	81	9.2	11.37	5.87	4.6	31.8	0.03*

[#]p-value for median difference between HIV+ and HIV- rural male participants using Chi-squared or Fisher's exact test, as appropriate.

In urban areas, the median WC of HIV-infected men (75.0 cm) was slightly lower than that of HIV-uninfected men (78.0 cm), but the differences was only marginally significant (p = 0.05). However, HIV-infected urban men had significantly lower median MUAC (23.0 cm vs. 24.5 cm, p = 0.02), triceps (7.0 cm vs. 9.0 cm, p = 0.015) and median body fat percentage (7.6% vs. 9.4%, p = 0.001) compared to HIV-uninfected urban men.

Table 6.3: Anthropometric information of HIV-infected and HIV-uninfected males in urban communities

Variable	Urban												
	HIV+						HIV-						
	N	Median	Mean	SD	Min	Max	N	Median	Mean	SD	Min	Max	p-value[#]
BMI (kg/m²)	36	19.4	19.8	2.58	14.5	25.3	61	20.9	22.64	6.6	14.7	49.9	0.07
WC (cm)	36	75.0	74.4	6.8	60.0	85.0	61	78.0	80.92	16.3	47.0	138.0	0.05
MUAC (cm)	36	23.0	23.18	2.45	18.5	28.0	61	24.5	26.0	6.6	19.0	62.0	0.02*
Triceps (cm)	36	7.0	7.5	3.8	3.0	20.0	61	9.0	12.0	10.7	3.0	60.0	0.015*
Body fat percentage (%)	36	7.6	8.0	1.9	5.11	14.4	61	9.4	11.29	6.5	5.1	40.31	0.001*

[#]p-value for median difference between HIV+ and HIV- urban male participants using Chi-squared or Fisher's exact test, as appropriate

Table 6.4 and Table 6.5 illustrate the median anthropometric information of HIV-infected and HIV-uninfected rural and urban females. In Table 6.4, the median BMI of HIV-infected rural women fell within the normal weight at 23.1 kg/m² and the median BMI of HIV-uninfected rural women fell in the overweight category at 27.7 kg/m², with a significant median difference of 4.6 kg/m² (p = 0.009). The median WC of HIV-infected women (81.5 cm) was significantly lower than that of HIV-uninfected

women (92.0 cm) (p = 0.001). Similarly, MUAC were significantly lower in HIV-infected women (28.1 cm vs. 32.0 cm, p = 0.001), as well as triceps (16.0 cm vs. 25.0 cm, p = 0.0001), and median body fat percentage (20.8% vs. 30.2%, p = 0.001) compared to HIV-uninfected rural women.

Table 6.4: Anthropometric information of HIV-infected and HIV-uninfected females in rural communities

Variable	Rural												
	HIV+						HIV-						
	N	Median	Mean	SD	Min	Max	N	Median	Mean	SD	Min	Max	p-value[#]
BMI (kg/m²)	63	23.1	24.9	6.8	13.7	42.5	359	27.7	28.8	8.9	11.9	53.6	0.009*
WC (cm)	63	81.5	83.7	14.8	61.5	121.3	359	92.0	92.2	17.4	36.0	166.0	0.001*
MUAC (cm)	62	28.1	28.5	5.8	15.0	42.0	356	32.0	32.4	7.1	19.0	64.0	0.01*
Triceps (cm)	62	16.0	18.4	9.6	4.0	50.0	354	25.0	25.6	12.9	2.0	63.0	0.0001*
Body fat percentage (%)	56	20.8	23.0	9.7	8.7	47.3	300	30.2	30.4	11.0	10.2	60.5	0.001*

[#]p-value for median difference between HIV+ and HIV- rural female participants using Chi-squared or Fisher's exact test, as appropriate

In Table 6.5, the median BMI of HIV-infected and HIV-uninfected urban women fell within the overweight and obese category at 31.8 kg/m² and 25.0 kg/m² respectively, with a significant median difference of 6.8 kg/m² (p = 0.001). The median WC of HIV-infected women (79.0 cm) was significantly lower than that of HIV-uninfected women (95.0 cm) (p = 0.001). Similarly, MUAC were significantly lower in HIV-infected women (26.5 cm vs. 31.5 cm, p = 0.001), as well as triceps (20.0 cm vs. 31.0 cm, p = 0.0001) and median body fat percentage (23.1% vs. 32.8%, p = 0.001) compared to HIV-uninfected urban women.

Table 6.5: Anthropometric information of HIV-infected and HIV-uninfected females in urban communities

Variable	Urban												
	HIV+						HIV-						
	N	Median	Mean	SD	Min	Max	N	Median	Mean	SD	Min	Max	p-value[#]
BMI (kg/m²)	131	25.0	26.0	7.6	13.3	55.7	185	31.8	32.4	8.8	14.5	55.1	0.001*
WC (cm)	131	79.0	81.8	15.5	57.0	143.0	185	95.0	95.0	17.0	60.0	143.0	0.001*
MUAC (cm)	131	26.5	26.7	5.3	15.0	46.0	185	31.5	31.4	6.1	18.0	58.0	0.001*
Triceps (cm)	131	20.0	22.1	10.6	4.0	56.0	185	31.0	31.6	12.5	5.0	85.0	0.0001*
Body fat percentage (%)	130	23.1	24.7	9.4	6.8	58.8	183	32.8	33.4	11.0	8.7	68.8	0.001*

[#]p-value for median difference between HIV+ and HIV- urban female participants using Chi-squared or Fisher's exact test, as appropriate

Table 6.6 illustrates categories of anthropometric variables of HIV-infected and HIV-uninfected participants in rural and urban communities.

The prevalence of underweight in HIV-infected participants was high in rural groups for males and females, ranging from 15.9% in rural HIV-infected women to 48.0% in rural HIV-infected men. Overall more women were overweight and obese than men, with HIV-uninfected women sharing the highest prevalence of obesity in rural (41.0%) and urban (56.2%) groups. Almost 14% of HIV-infected women living in urban areas were underweight compared to only 4.9% of HIV-uninfected women, which was a statistically significant difference ($p = 0.005$). Significantly more HIV-infected urban women were classified as normal weight (35.9%) compared to HIV-uninfected urban women (17.8%) ($p = 0.0003$), who tended to be more obese (56.2%), compared to HIV-infected urban women (19.9%), a difference which was also statistically significant ($p = 0.0001$). In rural areas, significantly more HIV-uninfected women were obese (41.0%) compared to HIV-infected women (23.8%) ($p = 0.009$).

More than half of HIV-infected men and women in all groups had a WC that fell below 94 cm and 80 cm respectively, indicating that they were within the normal WC range. Significantly more HIV-infected urban men fell within the normal WC range (100.0%) than HIV-uninfected men (16.7%) ($p = 0.04$). A larger percentage of HIV-infected women had a WC below 80cm compared to HIV-uninfected women, a difference that was also statistically significant ($p = 0.0003$ in rural areas and $p = 0.0001$ in urban areas). Significantly more HIV-uninfected women tended to have a WC in the “high risk” category (WC of more than 88 cm) compared to HIV-infected women ($p = 0.0003$ in rural areas and $p = 0.0001$ in urban areas).

Table 6.6: Categories of BMI, WC and MUAC skinfolds of HIV-infected and HIV-uninfected participants in rural and urban communities

Anthropometric variables	Male										Female									
	Rural					Urban					Rural					Urban				
	HIV+		HIV-			HIV+		HIV-			HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]	n	%	n	%	p-value[3]	n	%	n	%	p-value[4]
BMI Males: Rural: HIV+=25, HIV-=85; Urban: HIV+=36, HIV-=61 Females: Rural: HIV+=63, HIV-=359; Urban: HIV+=131, HIV-=185																				
<18.5kg/m^2 (Underweight)	12	48.0	26	30.6	0.10	10	27.8	12	19.7	0.35	10	15.9	40	11.1	0.28	18	13.7	9	4.9	0.005*
18.5– 24.9 kg/m^2 (Normal)	9	36.0	38	44.7	0.43	24	66.7	34	55.7	0.28	26	41.3	92	25.6	0.01	47	35.9	33	17.8	0.0003*
25–29.9 kg/m^2 (Overweight)	3	12.0	13	15.3	1.0	2	5.6	11	18.0	0.13	12	19.1	80	22.3	0.56	40	30.5	39	21.1	0.06
≥30 kg/m^2 (Obese)	1	4.0	8	9.4	0.68	0	0.0	4	6.6	0.29	15	23.8	147	41.0	0.009*	26	19.9	104	56.2	0.0001*
Waist circumference (WC) Males: Rural: HIV+=25, HIV-=86; Urban: HIV+=36, HIV-=18 Females: Rural: HIV+=64; HIV-=360; Urban: HIV+=131, HIV-=185																				
Normal WC (Male:<94cm;Female:<80cm)	21	84.0	71	82.6	0.55	36	100.0	3	16.7	0.04*	32	50.0	78	21.7	0.0003*	66	50.4	35	18.9	0.0001*
At risk WC (Male:≥94cm;Female:≥80cm)	2	8.0	8	9.3	1.0	0	0.0	4	22.2	0.29	9	14.1	66	18.3	0.69	27	20.6	35	18.9	0.93
High risk WC (Male:≥102cm;Female:≥88cm)	2	8.0	7	8.1	0.68	0	0.0	11	61.1	0.30	23	35.9	216	60.0	0.0003*	38	29.0	115	62.2	0.0001*
Upper-arm circumference Males: Rural: HIV+=25, HIV-=85; Urban: HIV+=36, HIV-=61 Females: Rural: HIV+=63, HIV-=356; Urban: HIV+=131, HIV-=185																				

Table 6.6: Categories of BMI, WC and MUAC skinfolds of HIV-infected and HIV-uninfected participants in rural and urban communities (continued)

Anthropometric variables	Male										Female									
	Rural					Urban					Rural					Urban				
	HIV+		HIV-			HIV+		HIV-			HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]	n	%	n	%	p-value[3]	n	%	n	%	p-value[4]
<15th percentile	20	80.0	58	68.2		36	100.0	52	85.3		22	34.9	84	23.6		58	44.3	39	21.1	
15th -75th percentile	3	12.0	18	21.2	0.58	0	0.0	4	6.6	0.05	29	46.0	129	36.2	0.0005*	55	42.0	75	40.5	0.0001*
>75th percentile	2	8.0	9	10.6		0	0.0	5	8.2		12	19.1	143	40.2		18	13.7	71	38.4	
Triceps skinfold Males: Rural: HIV+=25, HIV-=85; Urban: HIV+=36, HIV-=61 Females: Rural: HIV+=63, HIV-=354; Urban: HIV+=274, HIV-=185																				
<15th percentile	12	48.0	23	27.1	0.12	17	47.2	21	34.4	0.05	28	44.4	73	20.6	0.0001*	38	29.0	18	9.7	0.0001*
15th -75th percentile	8	32.0	43	50.6		18	50.0	28	45.9		27	42.9	159	44.9		105	51.2	77	41.6	
>75th percentile	5	20.0	19	22.4		1	2.8	12	19.7		8	12.7	122	34.5		131	19.9	90	48.7	

[1]p-value for difference between HIV+ and HIV- rural male participants using Chi-squared or Fisher's exact test, as appropriate

[2]p-value for difference between HIV+ and HIV- urban male participants using Chi-squared or Fisher's exact test, as appropriate

[3]p-value for difference between HIV+ and HIV- rural female participants using Chi-squared or Fisher's exact test, as appropriate

[4]p-value for difference between HIV+ and HIV- urban female participants using Chi-squared or Fisher's exact test, as appropriate

Table 6.7: Categories of body fat percentages of HIV-infected and HIV-uninfected men and women in rural and urban communities

Anthropometric variables	Rural					Urban				
	HIV+		HIV-		p-value[1]	HIV+		HIV-		p-value[2]
Males: Rural: HIV+=24, HIV-=81; Urban: HIV+=36, HIV-=61										
Body fat percentage males										
≤5% (low)	1	4.2	1	1.2	0.40	0	0.0	0	0.0	
6-15% (acceptable low)	20	83.3	64	79.0	0.77	36	100.0	52	85.3	0.02*
16-24% (acceptable high)	3	12.5	12	14.8	1.0	0	0.0	6	9.8	0.08
≥25% (high)	0	0.0	4	4.9	0.57	0	0.0	3	4.9	0.30
Females: Rural: HIV+=56, HIV-=300; Urban: HIV+=130, HIV-=183										
Body fat percentage females										
≤8% (low)	0	0.0	0	0.0		1	0.8	0	0.0	0.41
9-23% (acceptable low)	33	58.9	87	29.0	0.0001*	63	48.5	31	16.9	0.001*
24-31% (acceptable high)	11	19.6	70	23.3	0.55	38	29.2	47	25.6	0.48
≥32% (high)	12	21.4	143	47.7	0.57	28	21.5	105	57.4	0.49

[1]p-value for difference between HIV+ and HIV- rural participants using Chi-squared or Fisher's exact test, as appropriate

[2]p-value for difference between HIV+ and HIV- urban participants using Chi-squared or Fisher's exact test, as appropriate

A very high percentage of HIV-infected men had a MUAC that fell below the 15th percentile, ranging from 80% in HIV-infected rural men to 100% of HIV-infected men living in urban areas. In women, differences in MUAC differed significantly between HIV-infected women and HIV-uninfected women (p = 0.0005 in rural areas and 0.0001 in urban areas). HIV-infected women were more likely to fell below the 15th percentile for MUAC, with HIV-uninfected women falling within the 15th to 75th percentile categories.

In women, differences in triceps skinfold thickness differed significantly between HIV-infected women and HIV-uninfected women (p = 0.0001 in rural areas and p = 0.0001 in urban areas) with HIV-infected women having a lower triceps skinfold. A large percentage of women in all groups had triceps skinfolds between the 15th and 75th percentiles.

A significantly higher percentage of HIV-infected urban men had a body fat percentage between 6-15% (100%) compared to HIV-uninfected urban men (85.3%) (p = 0.02) (Table 6.7). Most HIV-infected women fell within the acceptable low category (9-23%) (58.9% rural and 48.4% urban), while most HIV-uninfected women fell in the high body fat percentage category (≥ 32%), ranging from 47.7% in rural areas to 57.4% in urban areas. A higher percentage of HIV-infected women had a body fat percentage between 9-23% compared to HIV-uninfected women (58.9% vs. 29.0% in rural areas, p = 0.0001; 48.5% vs. 16.9% in urban areas, p = 0.001), differences which were statistically significant.

Anthropometric variables in HIV-infected urban participants on ART and not on ART

No significant differences in anthropometric variables were found for HIV-infected urban participants on ART and not on ART (not indicated in a table).

Anthropometric factors associated with HIV status

In addition to descriptive comparisons between HIV-infected and HIV-uninfected participants, logistic regression was used to identify significant anthropometric factors associated with HIV status.

Anthropometric factors associated with HIV status in rural participants

The following anthropometric variables were considered for inclusion in the model:

BMI category (< 18.5, 18.5-24.9, 25-29.9, 30+), WC (normal, at risk, high risk), and body fat (low, acceptable low, acceptable high, high). The other anthropometric factors (i.e. triceps skinfold in body fat) were not considered since they are incorporated in the chosen variables. Age and body fat were selected in the model with odds ratios as indicated in Table 6.8.

Table 6.8: Anthropometric factors associated with HIV status (rural)

Variable		Odds ratio (95% CI)	p-value
Age		0.93 (0.91; 0.95)	<0.0001
Body fat	low vs. high	15.56 (0.80; 303.81)	<0.0001
	acceptable low vs. high	4.21 (2.13; 8.31)	
	acceptable high vs. high	1.85 (0.81; 4.22)	

In this rural sample, for every year that age increased, the odds of having HIV decreased (by 7%). As far as body fat percentages in the rural sample were concerned, having a low vs. high body fat percentage was positively associated with HIV-infection (odds ratio 15.56). Similarly HIV-infection was positively associated with an acceptable low body fat percentage vs. high (odds ratio 4.21) and acceptable high vs. high (odds ratio 1.85).

Anthropometric factors associated with HIV status in urban participants

The following anthropometric variables were considered for inclusion:

BMI category (<18.5, 18.5-24.9, 25-29.9, 30+), WC (normal, at risk, high risk) and body fat (low and acceptable low; acceptable high; high). Age and body fat and gender were selected in the model with odds ratios as indicated in Table 6.9.

Table 6.9: Anthropometric factors associated with HIV status (urban)

Variable		Odd ratio (95% CI)	p-value
Age		0.93 (0.91; 0.95)	<0.0001
Gender: male vs. female		0.29 (0.15; 0.53)	<0.0001
Body fat	<15% vs. 25%+	9.18 (4.89; 17.23)	<0.0001
	16-24% vs. 25%+	2.73 (1.46; 5.12)	

In the urban sample, for every year that age increased, the odds of having HIV decreased (by 7%). In this sample, male gender was negatively associated with HIV-infection (odds ratio 0.29). In terms of body fat percentages in the urban sample, HIV-infection was positively associated with a low or acceptable low body fat percentage vs. high (odds ratio 9.18).

DISCUSSION

The typical pattern of unintentional weight loss and wasting, characterised by lean body-mass depletion with a decrease in skinfold thickness and MUAC, is a common but serious indicator of HIV/AIDS-infection (Fenton and Silverman, 2008:1008). In the present study, median BMI, WC, MUAC and body fat percentages of HIV-infected men and women were lower than in HIV-uninfected men and women, living in both rural and urban areas. These adverse anthropometric outcomes can result from a range of factors such as inadequate food intake, malabsorption, metabolic disturbances, uncontrolled opportunistic infections and lack of physical activity (Fenton and Silverman, 2008:1008). In addition, the younger mean age of HIV-infected participants should be kept in mind, since weight gain is often the result of aging.

An analysis of demographic and health surveys from 11 sub-Saharan African countries estimated that 10.3% of HIV-infected women (aged 15-49 years) had BMIs of less than 18.5 kg/m² (Uthman, 2008). In contrast, a higher percentage of HIV-infected women in this study had a low BMI, especially those living in rural areas where more than a third of HIV-infected women had a BMI of less than 18.5 kg/m^2. In terms of males, almost fifty percent of HIV-infected rural men had a BMI of less than 18.5 kg/m^2. The results from the Transition in Health during Urbanisation of South Africans (THUSA) study performed in the North West province in South Africa showed no differences in BMI of HIV-infected and HIV-uninfected participants (26.1 kg/m^2 and 27.0 kg/m^2 respectively) (Nienaber *et al.,* 2000), possibly due to the fact that the participants included in this random sample included both healthy and ill participants, whereas the THUSA study only included apparently healthy subjects over a much wider age range, who may have been recently infected.

In the present study, a high percentage of urban women were overweight or obese, but with no significant difference between those that took ART and those not on treatment. Results from the THUSA study also confirmed high prevalence of overweight (25.5%) and obesity (28.6%) among healthy black women (Kruger *et al.*, 2001).

Despite the weight gain associated with the use of ART reported in a number of studies, results from the current study showed no significant differences in anthropometric variables in participants on ART and not on ART. Possible reasons for this finding might include the fact that patients on ART were in a more advanced stage of HIV (and thus qualified for treatment) compared to those not yet on ART. Initial side-effect of ART may also have resulted in weight loss. One of the limitations of the study was that the period of ART was not noted, making it difficult to ascribe differences in anthropometric variables to long-term use of ART.

Starvation results in predominant loss of body fat and to a lesser degree of lean body mass. The malnutrition associated with HIV-infection and AIDS, however, has characteristics related to other infection processes and some that are unique to HIV (Fenton and Silverman, 2008:1008). People with HIV/AIDS tend to lose body cell mass, in contrast to uncomplicated starvation in which fat stores are depleted to a higher extent (Fenton and Silverman, 2008:1008). Weight loss predominantly reflects the loss of lean body mass, which has been shown to be a strong predictor of survival, independent of CD4 count (Friis *et al.,* 2002). It is well documented that there is a strong association between weight loss and survival, and it has been suggested that 5% weight loss can have an independent adverse impact on disease progression (Paton *et al.,* 2005). It is, however, important to look at weight loss over time and not only BMI (ASSAf, 2007). Factors that might contribute to lower body fat percentages may include poor socio-demographic circumstances, household food insecurity, low dietary diversity and malnutrition that occur more commonly in HIV-infected persons.

In the current study, more women were overweight and obese than men. This was also found in HIV-infected women compared to HIV-infected men. Epidemiological studies have shown gender

differences in the prevalence of obesity in African nations, with levels much higher in females than males (Puoane *et al.,* 2002; Abubakari *et al.,* 2008). Data from African studies also show that obesity is most prevalent in urban, middle-aged females (Puoane *et al.,* 2002; Abubakari *et al.,* 2008). In a South African study of black HIV-infected females living in Mangaung and not on any current treatment for HIV-infection, the prevalence of obesity was generally high (Hattingh *et al.*, 2011). Results from the THUSA study also confirmed high prevalence rates of overweight and obesity among black women (Kruger *et al.*, 2001). In a Kenyan study where body composition changes and nutrient intake of HIV-infected people were studied, it was also found that the men were leaner than the women (Onyango *et al.*, 2011). In the urban sample, HIV-infection was negatively associated with male gender (odds ratio 0.29) (the number of men included in the study were, however, not high which makes it difficult to draw firm conclusions).

Generally, most HIV-infected participants had a WC that was not in the high risk category, but significantly more HIV-infected urban men fell within the normal WC range compared to HIV-uninfected men who were more likely to fall in the high risk category. In rural and urban areas, significantly more HIV-infected women also had a WC in the low risk category than HIV-uninfected women, who tended to fall in the high risk WC category. This correlates with the higher percentage HIV-infected women showing signs of wasting.

A higher percentage of HIV-infected men had low MUAC and triceps skinfold than HIV-uninfected men. In women, MUAC and triceps skinfold thickness differed significantly between HIV-infected women and HIV-uninfected women. MUAC measurements are often used to screen for PEM, when the amount of subcutaneous fat is likely to be small (Gibson, 2005:326), which was the case in many HIV-infected participants in this study. Decreased MUAC and skinfold thicknesses are common indicators of HIV/AIDS-infection (Fenton and Silverman, 2008: 1008), and are associated with poor disease prognosis and a low survival rate (Tang, 2003).

Results from the multiple regression confirm that lower body fat percentage is associated with HIV-infection, even when adjusting for age. In the current study significantly more HIV-infected

urban men had an acceptable low body fat percentage compared to HIV-uninfected urban men who tended to have a higher body fat percentage, while significantly more HIV-infected urban women had an acceptable low body fat percentage compared to HIV-uninfected urban women, of whom a large percentage fell in the unhealthy body fat percentage category (≥ 32.0%). Mulligan *et al.* (1997) found that HIV-infected men with a lower body fat content at the onset of wasting lost more lean body mass than those with a higher body fat percentage, confirming that the loss of body mass depends on the percentage of body fat prior to weight loss. For women, similar results were found by Hattingh *et al.* (2011), who reported that 65.9% of HIV-infected young women and 79.3% of older HIV-uninfected women had excessive fat. The median fat percentage, regardless of age, fell within the unhealthy category (indicating excess body fat). This study used the same cut-off point for body fat percentage than Hattingh *et al.* (2011), where a body fat percentage equal to or larger than 32.0% were classified as unhealthy or too much fat. Results from the THUSA study showed higher mean fat percentages of 42.9% for HIV-uninfected and 43.9% for HIV-infected women, determined using the sum of seven skinfolds (Nienaber *et al.,* 2000).

We acknowledge there is a certain degree of bias regarding the age of rural volunteers in the study. Older and unemployed individuals were more likely to participate. More women than men participated in the study probably due to men being labourers and formally employed and therefore not available for interviews conducted during the day. It is also possible that ill persons may have been more likely to participate in the study where medical examinations were conducted due to limited health services, especially in rural areas. Due to these reasons, the authors acknowledge that the study group is probably not representative of the general population.

CONCLUSIONS

HIV-infected rural and urban participants consistently had lower BMI, WC, MUAC and triceps skinfolds, compared to HIV-uninfected participants. In both samples, HIV-infection was positively associated with a lower fat percentage, which is probably an outcome of HIV-infection.

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CHAPTER 7

Reported Health and Biochemical Profile of HIV-infected and HIV-uninfected Rural and Urban Communities in the Free State, South Africa

ABSTRACT

HIV-infection has a significant impact on health and quality of life. The objective of this study was to determine significant independent nutritional factors associated with HIV status in rural and urban communities in the Assuring Health for All (AHA) study. The AHA study was undertaken in rural Trompsburg, Philippolis and Springfontein (2007) and urban Mangaung (2009).

Adults between 25-64 years were eligible to participate. Of the 567 rural participants, 97 (17.1%) were HIV-infected. Of the 424 urban participants, 172 (40.6%) were HIV-infected. Logistic regression with forward selection ($p < 0.05$) was used to select significant independent reported health factors and coping strategies, as well as biochemical factors associated with HIV status. Variables with a p-value of < 0.15 were considered for inclusion in the model.

For every year that age increased, the odds of having HIV-infection decreased (by 8.0% in the rural sample and 7.0% in the urban sample). A negative association was found between being a member of a church and HIV-infection [(odds ratio 0.22 (95% CI 0.06; 0.76) in the rural sample and odds ratio 0.46 (95% CI 0.23; 0.91) in the urban sample)]. In rural areas, HIV-infection was positively associated with losing weight involuntarily (>3kg in the past 6 months) (odds ratio 1.86, 95% CI 1.08; 3.20); ever being diagnosed with TB (odds ratio 2.50, 95% CI 1.18; 5.23); being on TB treatment (odds ratio 3.29, 95% CI 1.00; 10.80); and having experienced death of a spouse during the past year (odds ratio 4.91, 95% CI 2.06; 11.73), all of which are possible outcomes of HIV-infection. In the urban sample, HIV-infection was positively associated with having diarrhoea for at least 3 days in the past 6 months (odds ratio 2.04, 95% CI 1.23; 3.41) and having ever been diagnosed with TB (odds ratio 2.49, 95% CI 1.37; 4.53).

These results confirm the higher prevalence of opportunistic infection and associated symptoms (such as diarrhoea and weight loss) that are outcomes of HIV-infection.

INTRODUCTION

The relation between nutrition and immunity is significant in Human Immunodeficiency Virus (HIV)-infected individuals [Academy of Science of South Africa (ASSAf), 2007:133]. In this context, poor nutritional status impairs an already compromised immune system, increasing vulnerability to opportunistic infections, which in turn leads to worsening of nutritional status (ASSAf, 2007:133). HIV-infection is a complex and progressive disease in which several factors [HIV-itself,

opportunistic infections, the host's immune system, and antiretroviral therapy (ART)] are able to influence biochemical parameters either directly or indirectly (Salas-Salvadó and García-Lorda, 2001), causing metabolic alterations.

HIV-infection has several effects on a person's overall health status. Opportunistic infections affecting the gastrointestinal tract may result in various types of malabsorption (ASSAf, 2007:125) and advanced immunosuppression from HIV-infection can also lead to gastrointestinal symptoms such as diarrhoea, nausea, vomiting, dysphagia, weight loss, as well as abdominal pain (Hill and Balkin, 2009).

The biochemical profile of HIV-infected patients is constantly changing (Nixon *et al.,* 2002), and therefore biochemical parameters should be monitored frequently. Abnormalities in protein, glucose and lipid metabolism have been evident in HIV-infected patients since recognition of the Acquired Immune Deficiency Syndrome (AIDS)-epidemic (Salas-Salvadón and Garcia-Lorda, 2001).

Cardiovascular disease is one of the most common causes of death in HIV-infected adults on highly active antiretroviral therapy (HAART) (Bader and Kelly, 2008). However, studies show that unless HIV-infected people with high blood lipids have other risk factors that increase risk for heart disease, such as smoking, obesity, or high blood pressure, their chances of heart attack are no greater than that of HIV-uninfected people (Kressy *et al.,* 2008). High triglyceride concentrations and low high-density lipoprotein (HDL)-cholesterol concentrations are abnormalities that increase risk for cardiovascular disease (Woods *et al.,* 2008). In addition, metabolic complications such as insulin resistance, diabetes mellitus, obesity, and abnormal fat distribution are associated with increased risk of cardiovascular disease (Bader and Kelly, 2008).

Persons diagnosed with HIV-infection experience many physical and psychosocial life events that can potentially overwhelm their ability to manage their daily lives (Alonzo and Reynolds, 1995). Life-event stressors (such as loss of job, marital separation/divorce, death of a spouse and food insecurity), particularly those events that are perceived as severe (Leserman *et al.,* 1999), as well

as denial of HIV-infection, were found to accelerate disease progression among people with HIV (Leserman *et al.,* 2000).

This study formed part of the baseline phase of the Assuring Health for All in the Free State (AHA-FS) study which aimed to determine how living in rural and urban communities can influence lifestyle and health. The aim of this sub-study was to determine medical and biochemical status of HIV-infected and HIV-uninfected rural and urban respondents in the southern Free State. In addition, significant independent medical and biochemical factors associated with HIV status in this sample were determined.

METHODOLOGY

The rural study was performed in 2007 in three Free State towns, namely Trompsburg, Philippolis and Springfontein and the urban study in 2009 in Mangaung.

Study design

A cross-sectional study was undertaken.

Target population and sampling

In rural areas all households in black and coloured townships were eligible to participate. In urban Mangaung the number of plots in the Mangaung University Community Partnerships Programme (MUCPP) service area was counted on a municipal map and included Buffer, Freedom Square, Kagisanong, Chris Hani, Namibia and Turflaagte. An estimate was made of additional squatter households in open areas. A stratified proportional cluster sample was selected, stratified by area and formal plot/squatter households in open areas. Using randomly selected X and Y coordinates, one hundred starting points were selected in this way. From each point five adjacent starting households were approached to participate in the study.

Every adult member of households in these black and coloured communities, who gave informed consent and was between the age of 25-64 years, was eligible to participate.

Pilot study

Pilot studies were undertaken in five persons in each area, similar to the target group before the main survey in order to determine whether questions included in the questionnaire could be easily understood and to determine the amount of time needed to complete the questionnaires. All questionnaires and anthropometric measurements were piloted. Minor changes (mostly technical editing) were made to questionnaires after the pilot study.

Variables and operational definitions

For the purpose of this study reported health referred to social support (group membership, network of friends, family structure); tobacco and alcohol consumption patterns; medical history and medications; family medical history; levels of stress and behaviours related to the control of stress. Medical examination included heart rate, visible signs, cardiovascular abnormalities, respiratory abnormalities, abdominal pathology, nervous system abnormalities, skin pathology and HIV pre-test counselling. For the purpose of this study, only blood pressure (BP) will be reported. Laboratory determinations included full blood count, glycated haemoglobin (HbA1c), total cholesterol, HDL-cholesterol, triglycerides, fibrinogen, HIV status and CD4 cell count.

Methods and techniques

An adult health questionnaire, adapted from the one developed for the Prospective Urban Rural Epidemiology (PURE) study (Teo *et al.*, 2009), was completed for all adults in each household. Information was collected in an interview with each adult by trained final year dietetics students, using a structured questionnaire. Clinical information, including blood pressure, was collected by means of a medical examination performed by a medical practitioner and noted on a standard form. In this study, hypertension was defined as a current BP of systolic above 140 millimeter of mercury (mmHg) and/or diastolic above 90 mmHg (Conner *et al.,* 2005).

Respondents fasted overnight and blood samples were taken in the morning. In the rural study, blood and urine samples were collected by two chemical pathologists while in the urban leg of the study, blood and urine samples were collected by three registered nurses. All blood were analysed in an accredited laboratory using standard techniques. Sixty millimeters of blood was collected from each participant. Fasting glucose [normal value: fasting < 5.6 millimole per liter (mmol/L)] [WHO/International Diabetes Federation (IDF), 2009], HbA1c (normal value < 6.5%) [American Diabetes Association (ADA), 2010], serum triglyceride levels (normal value: fasting < 1.70 mmol/L), total cholesterol (normal value: fasting < 5.18 mmol/L), HDL (normal levels for men: > 1.0 mmol/L and women: > 1.3 mmol/L) and plasma fibrinogen [normal value: 1.5-4 gram per liter (g/L) (Dacie and Lewis, 1991:13)], were measured on fasting blood samples using standards laboratory techniques. Low density lipoprotein (LDL)-cholesterol levels (normal value < 2.59 mmol/L) were calculated indirectly with the Friedewald equation, namely [(LDL-cholesterol) = (total cholesterol) − (HDL-cholesterol) − (triglyceride)/5] (Friedewald *et al.*, 1972).

All physical examination and blood tests were done utilising standard methods; blood and urine samples were collected in the early morning with participants fasting. Blood and urine samples were immediately stored in ice filled containers and transported to the laboratory. The National Health Laboratory Service (NHLS) Laboratory, University of the Free State (UFS) was responsible for analysis of the rural samples and a private pathology laboratory was responsible for analysis of the urban samples.

Validity and reliability

To assure validity, all questions in the health questionnaire were related to the objectives of the study and were based on health-related issues discussed associated with HIV in relevant literature. Random samples of 10% of the rural and urban participants were interviewed a second time by the researchers to determine reliability of questions asked in the health questionnaire within a month of the initial survey. Where the percentage of answers to questions differed with more than 20%, the question was considered unreliable. No questions were found to be unreliable in the health questionnaire.

Medical examination included a valid clinical assessment of each participant. Reliability was assured by having qualified medical practitioners complete the medical examinations. The reliability of biochemical tests was assured by using standard laboratory techniques and controls.

Data collection

Before data was collected, induction meetings for community members and other role-players were arranged in each community. The role-players included clinic staff, church leaders, community leaders and any members of the community who were interested in learning more about the project or had questions that they wanted to ask. The meetings were held in community halls or in the community clinic. At these meetings community members also provided the names of community members that could assist in informing other members of the community about the project. Separate training sessions were then arranged during which these community members were trained on how to explain the information document to community members that were eligible to participate and to obtain informed consent. These community members were also responsible for visiting eligible households on one or more occasions and advising participants on precautions to take before participation (e.g. arrive in a fasting state) and reminding participants of the day on which they were to visit the research venue. This was especially important in urban areas, where participants from different areas were scheduled to visit the research venue on different days.

Data collection took place at different research venues, including the community hall in the rural area or at the MUCPP nutrition centre in the urban area.

On days of data collection, ID documents were screened in order to make sure that the participants met the inclusion criteria for age. The research venues included stations for the collection of blood and urine samples; a food station; medical examination; as well as anthropometric measurements. All stations needed to be completed in order to be included in the study. Thereafter, questionnaires related to the following were completed: socio-demography (one per household); household food security (one per household); 24-hour recall (one for each

participant); physical activity (one for each participant); and reported health (one for every participant).

Ethics

The study was approved by the Ethics Committee of Faculty of Health Sciences, UFS (ETOVS 21/07), as well as the Free State Department of Health (DoH) and local municipalities. The researchers obtained written information from all participants in their language of choice. Each household member received a participation letter in addition to the information document. This letter was used to inform them of the date they should attend the place of research to participate in the study. The procedures were also outlined in this document (for example, fasting on arrival). Another purpose of this document was to inform employers why the employee would not be able to attend work on that specific day. Rural and urban participants were given money for transport (R12) after they had completed all sections/stations on the data checklist. Those with critical medical problems were referred directly after the examination. Communities were revisited by doctors after the results from laboratory investigations were available. During these follow-up appointments, participants were given their test results as well as referral letters if necessary. Patients with medical problems were referred to nearby clinics and community healthcare centres.

Statistical analysis

Descriptive statistics, including frequencies and percentages (for categorical data) and means and standards deviations (SDs) (for symmetrical numerical variables) or medians and percentiles (for skew numerical variables), were calculated. Where the “other” category was indicated by more than 5% of respondents, the given answers are indicated in the table. Differences between HIV-infected and HIV-uninfected rural groups, HIV-infected and HIV-uninfected urban groups, and HIV-infected urban respondents on ART and HIV-infected urban respondents not on ART were assessed by p-values [t-tests (for symmetrical numerical variables), Mann-Whitney tests (for skew numerical variables), chi-squared tests (for categorical variables) or Fischer’s extract test (for categorical variables with sparse data)] or 95% confidence intervals (CIs) for median, mean or percentage differences. All analyses were performed by the Department of Biostatistics, University of the Free

State. Logistic regression with forward selection ($p < 0.05$) was used to select significant independent factors associated with HIV status. Variables with a p-value of < 0.15 were considered for inclusion in the model. Age and gender were entered in each model as possible factors.

RESULTS

Of the 570 rural participants, 567 had HIV results. Of these, 97 (17.1%) were HIV-infected. Of the 426 urban participants, 424 had HIV results. Of these, 172 (40.6%) were HIV-infected.

It should be noted that participants were included if all assessments or questionnaires had been completed. However, within questionnaires it was possible that not all questions had been answered, and for this reason missing values could occur (as indicated by n-values in tables).

Although not indicated in table format, the reported health results of urban participants on ART and those not on ART were also compared. Twenty five percent (43 respondents) of HIV-infected urban respondents were using ART compared to only four HIV-infected respondents (4.1%) in rural areas. Due to this low number, HIV-infected rural participants on ART were not included in the comparison of patients using ART and those not using ART.

In Table 7.1 the median age of rural and urban respondents is described.

Table 7.1: Age of HIV-infected and HIV-uninfected rural and urban respondents

	HIV+						HIV-							
	N	**Median**	**25%**	**75%**	**Min**	**Max**	**N**	**Median**	**25%**	**75%**	**Min**	**Max**	**p-value[#]**	**95% CI**
Rural	92	40.5	34.0	49.5	27.0	65.0	455	40.0	51.0	57.0	25.0	65.0	0.001*	[-10; -5]
Urban	171	38.0	32.0	47.0	25.0	63.0	248	40.0	49.0	56.0	25.0	64.0	0.0001*	[-10; -6]

[#]p-value for median difference between HIV+ and HIV- participants using t-tests or Mann-Whitney, as appropriate

HIV-infected rural participants were significantly younger (median age 40.5 years) than HIV-uninfected rural participants (median age 51 years) ($p = 0.001$). HIV-infected urban participants

were also significantly younger (median age 38 years) than HIV-uninfected urban participants (median age 49 years) (p = 0.0001). The median age of HIV-infected participants in rural areas were slightly higher than in urban areas at 40.5 and 38 years respectively.

The median age of HIV-infected urban participants on ART was 38 years, which was very similar to those not on ART at 38.5 years (not included in a table).

Results related to smoking and use of snuff is shown in Table 7.2 and Table 7.3. In both areas, more or less the same percentage of HIV-infected participants smoked or snuffed compared to HIV-uninfected participants.

Table 7.2: History of smoking and use of snuff of HIV-infected and HIV-uninfected rural and urban participants

Variable	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
History of smoking Rural: HIV+=88, HIV-=452; Urban: HIV+=164, HIV-=244										
Never smoked	35	39.8	190	42.0		113	68.9	162	66.4	
Currently smoke	36	40.9	179	39.6	0.81	39	23.8	52	21.3	0.55
Formerly smoked	17	19.3	83	18.4		12	7.3	30	12.3	
History of use of snuff Rural: HIV+=87, HIV-=449; Urban: HIV+=164, HIV-=244										
Never used snuff	68	78.2	346	77.1		111	67.7	170	69.7	
Currently use snuff	15	17.2	79	17.6	0.93	41	25.0	62	25.4	0.92
Formerly used snuff	4	4.6	24	5.4		12	7.3	12	4.9	

[1]p-value for difference between HIV+ and HIV- rural participants using Chi-squared or Fisher's exact test, as appropriate

[2]p-value for difference between HIV+ and HIV- urban participants using Chi-squared or Fisher's exact test, as appropriate

A fairly larger percentage of HIV-infected rural participants smoked (40.9%) compared to HIV-infected urban people (23.8%). In contrast more HIV-infected urban participants snuffed (25.0%) compared to HIV-infected rural participants (17.2%), but was not significant.

HIV-infected rural participants started to snuff at a younger age (median age 27 years) than HIV-uninfected rural participants (median age 40 years).

Table 7.3: Smoking and use of snuff of HIV-infected and HIV-uninfected rural and urban participants

Variable	HIV+				HIV-				
	N	25%	Median	75%	N	25%	Median	75%	p-value[#]
Rural									
Rural: HIV+=36, HIV-=179									
Median number of cigarettes/ day	36	2.0	3.5	10.0	176	2.0	3.5	6.0	0.30
Median age started smoking	36	15.0	18.0	20.5	171	16.0	19.0	23.0	0.94
Rural: HIV+=15, HIV-=79									
Median times /day snuff	14	2.0	2.0	3.0	76	2.0	3.0	3.0	
Median age started	15	20.0	27.0	33.0	75	30.0	40.0	50.0	
Urban									
Urban: HIV+=39, HIV-=52									
Median number of cigarettes/ day	36	3.0	5.0	6.0	47	2.0	4.0	6.0	0.41
Median age started smoking	36	15.0	18.0	23.5	48	16.5	18.0	21.0	0.07
Urban: HIV+=41, HIV-=62									
Median times /day snuff	34	1.0	2.5	3.0	55	1.0	2.0	3.0	
Median age started	33	20.0	28.0	37.0	49	18.0	28.0	42.0	

[#]p-value for median difference between HIV+ and HIV- participants using t-tests or Mann-Whitney, as appropriate

A fairly high percentage of HIV-infected urban respondents did not smoke (67.4% on ART and 69.4% not on ART) or snuff (60.5% on ART and 70.3% not on ART). No significant differences in the percentages of HIV-infected urban respondents on ART and not on ART that smoked and snuffed occurred. HIV-infected participants on ART were, however, likely to start smoking at a younger age (median age 16.5 years) than HIV-infected urban participants not on ART (median age 19 years).

Table 7.4 and Table 7.5 illustrate categories of alcohol consumption and median alcohol intake of HIV-infected and HIV-uninfected rural and urban respondents. Overall more HIV-infected rural respondents (54.6%) consumed alcohol compared to HIV-infected urban respondents (42.3%).

In both groups a higher percentage of HIV-infected participants used alcohol compared to HIV-uninfected participants, but in both groups this difference was not statistically significant. More rural participants tended to use alcohol than urban participants, ranging from 47.6% in HIV-uninfected rural participants to 54.6% in HIV-infected rural participants. Beer was the most frequently consumed alcohol beverage in all groups, but rural respondents also consumed higher amounts of homemade beer, ranging from 47.8% in HIV-infected participants to 57.9% HIV-

uninfected participants. More HIV-infected rural respondents (84.2%) tended to feel tired on Mondays after heavy drinking than HIV-uninfected rural participants (61.8%), but the difference was not significant (p = 0.07).

Table 7.4: Alcohol consumption of HIV-infected and HIV-uninfected rural and urban participants

Variable	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
History of alcohol use Rural: HIV+=88, HIV-=450; Urban: HIV+=163, HIV-=244										
Never used alcohol	13	14.8	100	22.2		68	41.7	118	48.4	
Currently use alcohol	48	54.6	214	47.6	0.23	69	42.3	89	36.5	0.22
Formerly used alcohol	27	30.7	136	30.2		26	16.0	37	15.2	
If currently, what form										
Spirits Rural: HIV+=47 HIV-=204; Urban: HIV+=66, HIV-=84	10	21.3	34	16.7		7	10.6	5	6.0	
Wine Rural: HIV+=47 HIV-=206; Urban: HIV+=65, HIV-=83	8	17.0	41	19.9		8	12.3	10	12.1	
Beer, cider Rural: HIV+=46 HIV-=205; Urban: HIV+=66, HIV-=83	31	67.4	114	55.6		47	71.2	54	65.1	
Homemade beer Rural: HIV+=45 HIV-=202; Urban: HIV+=65 HIV-=83	22	47.8	117	57.9		13	20.0	24	28.9	
At least once a month consume >5 drinks /day Rural: HIV+=48; HIV-=206; Urban: HIV+=66, HIV-=83	21	43.8	88	42.7	0.89	26	39.4	34	41.0	0.84
Feel tired on Monday after heavy alcohol consumption (>5drinks/day) Rural: HIV+=19; HIV-=68; Urban: HIV+=22, HIV-=27	16	84.2	42	61.8	0.07	15	68.2	22	81.5	0.28

[1]p-value for difference between HIV+ and HIV- rural participants using Chi-squared or Fisher's exact test, as appropriate

[2]p-value for difference between HIV+ and HIV- urban participants using Chi-squared or Fisher's exact test, as appropriate

As seen in Table 7.5, rural respondents consumed an average of four drinks on weekends, while urban respondents reported an average of five drinks on weekends.

Table 7.5: Alcohol information of HIV-infected and HIV-uninfected rural and urban current drinkers

Variable	HIV+				HIV-				
	N	25%	Median	75%	N	25%	Median	75%	p-value[#]
Rural									
Rural: HIV+=48, HIV-=214									
Median age started using alcohol	48	18.0	20.0	26.0	202	18.0	23.0	30.0	0.10
On weekends, median number of drinks	48	2.0	4.0	6.0	206	3.0	4.0	6.0	0.97
Urban									
Urban: HIV+=69, HIV-=89									
Median age started using alcohol	62	18.0	20.0	27.0	80	19.0	22.5	30.0	0.36
On weekends, median number of drinks	61	3.0	5.0	8.0	75	2.0	5.0	8.0	0.79

[#]p-value for median difference between HIV+ and HIV- participants using t-tests or Mann-Whitney, as appropriate

Participants not on ART tended to drink more over weekends (median 5.0 number of drinks) than participants on ART (median 3.0 number of drinks). Most respondents felt tired on Mondays after heavy alcohol consumption (more than five drinks/day). None of these differences were, however, statistically significant.

Health information of HIV-infected and HIV-uninfected rural and urban participants

Health information of HIV-infected and HIV-uninfected rural and urban participants is described in Table 7.6.

Significantly more HIV-infected rural respondents had experienced chest pain or tightness [60.7% versus (vs.) 46.8%, p = 0.02] and cough during the past two weeks (53.9% vs. 40.8%, p = 0.02) compared to HIV-uninfected rural participants. The same trend was observed for breathlessness with usual activity (59.6% vs. 49.3%, p = 0.07), but the difference was not statistically significant. HIV-infected participants in both areas also reported experiencing significantly more loose stools and diarrhoea during the past six months compared to HIV-uninfected participants (rural = 38.2% vs. 27.7%, p = 0.04; urban = 32.9% vs. 19.8%, p = 0.002)**.**

In rural areas, HIV-infected respondents experienced significantly more vomiting than HIV-uninfected counterparts (32.6% vs. 21.8%, p = 0.02), as well as joint pain compared to HIV-

uninfected counterparts (55.7% vs. 70.1%, p = 0.008). In the past six months, significantly more HIV-infected urban participants reported loss of appetite than their HIV-uninfected counterparts (57.9% vs. 45.5%, p = 0.01) and skin rash compared to their HIV-uninfected counterparts (37.8% vs. 24.6%, p = 0.004). In rural areas, a statistically significantly higher percentage of HIV-infected respondents complained about involuntary weight loss of more than 3kg (64.0% vs. 50.3%, p = 0.01) with a trend in urban areas (47.6% vs. 37.7%, p = 0.05). A higher percentage of HIV-uninfected rural and urban respondents had experienced sexually transmitted diseases (STDs), rural = 13.5% vs. 7.1% (p = 0.04) and urban = 34.2% vs. 5.3%, (p = 0.0001).

A higher percentage of HIV-uninfected urban respondents (50.8%) complained about swelling of feet compared to HIV-infected urban respondents (40.9%), a difference that was statistically significant (p = 0.04). This might possibly be related to age: HIV-infected urban participants were significantly younger (median age 38 years) than HIV-uninfected urban participants (median age 49 years).

Reported HIV/AIDS prevalence was much higher in urban areas than in rural areas: 52.8% vs. 14.9%. In urban groups, the percentage of HIV-uninfected participants who stated that they had been diagnosed with diabetes mellitus (10.3%) was statistically higher than in HIV-infected participants (4.3%) (p = 0.02). In both groups, significantly more HIV-uninfected respondents had been diagnosed with hypertension compared to HIV-infected respondents (rural = 66.1% vs. 44.9%, p = 0.0002; urban = 57.0% vs. 35.4%, p = 0.0001).

A higher percentage of HIV-infected urban respondents (7.3%) experienced liver disease, hepatitis and/or jaundice compared to HIV-uninfected urban respondents (2.9%) (p = 0.03). HIV-infected participants in both groups were significantly more likely to have been diagnosed with TB: 27.3% vs. 10.2% in rural areas (p = 0.0001) and 24.4% vs. 10.7% in urban areas (p = 0.0002). In urban areas, HIV-infected participants had a significantly higher probability of family members also diagnosed with HIV than their HIV-uninfected counterparts: 43.3% vs. 30.3% (p = 0.007).

Table 7.6: Self reported health information of rural and urban participants

Variable	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
Experienced during last 6 months:										
Chest pain or tightness with usual activity Rural: HIV+=89; HIV-=451; Urban: HIV+=164, HIV-=243	54	60.7	211	46.8	0.02*	97	59.2	137	56.4	0.57
Breathlessness with usual activity Rural: HIV+=89; HIV-=452; Urban: HIV+=164, HIV-=244	53	59.6	223	49.3	0.07	81	49.4	129	52.9	0.49
Cough for at least 2 weeks Rural: HIV+=89; HIV-=451; Urban: HIV+=164, HIV-=244	48	53.9	184	40.8	0.02*	74	45.1	96	39.3	0.24
Wheezing or whistling in chest Rural: HIV+=89; HIV-=451; Urban: HIV+=164, HIV-=244	41	46.1	195	43.2	0.62	62	37.8	86	35.3	0.59
Loose stools, diarrhoea for at least 3 days Rural: HIV+=89; HIV-=451; Urban: HIV+=164, HIV-=243	34	38.2	125	27.7	0.04*	54	32.9	48	19.8	0.002*
Vomiting Rural: HIV+=89; HIV-=450; Urban: HIV+=164, HIV-=244	29	32.6	98	21.8	0.02*	41	25.0	47	19.3	0.16
Loss of appetite Rural: HIV+=89; HIV-=451; Urban: HIV+=164, HIV-=244	41	46.1	184	40.8	0.35	95	57.9	111	45.5	0.01*
Swelling of feet Rural: HIV+=89; HIV-=452; Urban: HIV+=164, HIV-=244	32	36.0	177	39.2	0.57	67	40.9	124	50.8	0.04*
Blood in urine Rural: HIV+=89; HIV-=452; Urban: HIV+=164, HIV-=244	11	12.4	32	7.1	0.09	11	6.7	18	7.4	0.79
Involuntary weight loss >3kg Rural: HIV+=89; HIV-=451; Urban: HIV+=164, HIV-=244	57	64.0	227	50.3	0.01*	78	47.6	92	37.7	0.05
Skin rash Rural: HIV+=89; HIV-=451; Urban: HIV+=164, HIV-=244	26	29.2	115	25.5	0.46	62	37.8	60	24.6	0.004*
Joint pain Rural: HIV+=88; HIV-=451; Urban: HIV+=164 HIV-=244	49	55.7	316	70.1	0.008*	96	58.5	163	66.8	0.09
STDs Rural: HIV+=89; HIV-=452; Urban: HIV+=164, HIV-=244	12	13.5	32	7.1	0.04*	56	34.2	13	5.3	0.0001*
Diagnosed with the following:										
Diabetes Mellitus Rural: HIV+=89; HIV-=450; Urban: HIV+=164, HIV-=244	5	5.6	55	12.2	0.07	7	4.3	25	10.3	0.02*
High blood pressure Rural HIV+=89; HIV-=451; Urban: HIV+=164, HIV-=244	40	44.9	298	66.1	0.0002*	58	35.4	139	57.0	0.0001*
Stroke Rural: HIV+=89; HIV-=452; Urban: HIV+=164, HIV-=244	8	9.0	27	6.0	0.29	9	5.5	11	4.5	0.65

Table 7.6: Self reported health information of rural and urban participants (continued)

Variable	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
Heart disease, angina, heart attack Rural: HIV+=89; HIV-=448; Urban: HIV+=164, HIV-=244	14	15.7	69	15.4	0.93	27	16.5	43	17.6	0.76
Heart failure Rural: HIV+=89; HIV-=452; Urban: HIV+=164, HIV-=244	1	1.1	5	1.1	1.0	8	4.9	11	4.5	0.86
Cancer Rural: HIV+=89; HIV-=452; Urban: HIV+=164, HIV-=244	0	0.0	6	1.3	0.59	3	1.8	6	2.5	0.74
Liver disease, hepatitis, jaundice Rural: HIV+=89; HIV-=452; Urban: HIV+=164, HIV-=244	4	4.5	12	2.7	0.31	12	7.3	7	2.9	0.03*
Lung disease, e.g. emphysema or asthma Rural: HIV+=89; HIV-=451; Urban: HIV+=164, HIV-=244	13	14.6	58	12.9	0.65	14	8.5	18	7.4	0.66
TB Rural: HIV+=88; HIV-=452; Urban: HIV+=164, HIV-=244	24	27.3	46	10.2	0.0001*	40	24.4	26	10.7	0.0002*
HIV/AIDS Rural: HIV+=87; HIV-=451; Urban: HIV+=163; HIV-=243	13	14.9	1	0.2		86	52.8	5	2.1	
Epilepsy Rural: HIV+=89; HIV-=451; Urban: HIV+=164, HIV-=244	4	4.5	22	4.9	1.0	11	6.7	14	5.7	0.68
Allergy Rural: HIV+=89; HIV-=451; Urban: HIV+=164, HIV-=244	12	13.5	68	15.1	0.69	28	17.1	45	18.4	0.72
Family member diagnosed with the following:										
Diabetes Mellitus Rural: HIV+=88; HIV-=449; Urban: HIV+=164, HIV-=244	28	31.8	110	24.5	0.15	53	32.3	82	33.6	0.78
High blood pressure Rural: HIV+=88; HIV-=448 Urban: HIV+=164, HIV-=244	55	62.5	277	61.8	0.90	96	58.5	156	63.9	0.27
Stroke Rural: HIV+=88; HIV-=447; Urban: HIV+=164, HIV-=244	13	14.8	70	15.7	0.83	33	20.1	41	16.8	0.39
Heart disease, angina, heart attack Rural: HIV+=88; HIV-=446; Urban: HIV+=164, HIV-=244	17	19.3	83	18.6	0.87	40	24.4	68	27.9	0.43
Heart failure Rural: HIV+=88; HIV-=448; Urban: HIV+=164, HIV-=244	5	5.7	28	6.2	0.84	11	6.7	16	6.6	0.95
Cancer Rural: HIV+=88; HIV-=449; Urban: HIV+=164, HIV-=244	12	13.6	56	12.5	0.76	18	11.0	27	11.1	0.97
Liver disease, hepatitis, jaundice Rural: HIV+=88; HIV-=450; Urban: HIV+=164, HIV-=244	13	14.8	38	8.4	0.06	11	6.7	13	5.3	0.56

Table 7.6: Self reported health information of rural and urban participants (continued)

Variable	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
Lung disease, e.g. emphysema or asthma Rural: HIV+=88; HIV-=449; Urban: HIV+=164, HIV-=244	14	15.9	79	17.6	0.70	34	20.7	47	19.3	0.71
TB Rural: HIV+=88; HIV-=450 Urban: HIV+=164, HIV-=244	26	29.6	99	22.0	0.12	63	38.4	79	32.4	0.20
HIV/AIDS Rural: HIV+=88; HIV-=449; Urban: HIV+=164, HIV-=244	6	6.8	39	8.7	0.56	71	43.3	74	30.3	0.007*
Epilepsy Rural: HIV+=88; HIV-=447; Urban: HIV+=164, HIV-=244	11	12.5	32	7.2	0.09	18	11.0	29	11.9	0.77
Allergy Rural: HIV+=88; HIV-=450; Urban: HIV+=164, HIV-=244	8	9.1	34	7.6	0.62	34	20.7	36	14.8	0.16
Medication										
Taking medication regularly Rural: HIV+=88; HIV-=448; Urban: HIV+=164, HIV-=244	62	70.5	347	77.5	0.16	90	54.9	132	54.1	0.87
Types of medication Rural: HIV+=62; HIV-=347; Urban: HIV+=90, HIV-=132										
ARTs	4	6.5	0	0.0	0.0001*	43	47.8	0	0.0	
Diabetes (oral)	2	3.2	42	12.1	0.02*	0	0.0	13	9.9	0.0027*
Hypertension	28	45.2	252	72.6	0.0001*	22	24.4	90	68.2	0.0001*
TB Treatment	10	16.1	8	2.3	0.0001*	10	11.1	4	3.0	0.01*
Other	54	87.1	314	90.5		46	51.1	49	37.1	
Hospitalised during past 12 months Rural: HIV+=88; HIV-=451; Urban: HIV+=164, HIV-=244	26	29.6	104	23.1		46	28.1	65	26.6	
Details of hospitalisation Rural: HIV+=26; HIV-=103; Urban: HIV+=43, HIV-=60										
Lung disease (emphysema, asthma, bronchitis)	2	7.7	2	1.9	0.17	4	9.3	3	5.0	0.45
Orthopaedics	6	23.1	27	26.2	0.76	2	4.7	6	10.0	0.46
Maternity	2	7.7	6	5.8		7	16.3	8	13.3	0.74
Other	16	61.5	68	66.0		30	69.8	43	71.7	

Table 7.6: Self reported health information of rural and urban participants (continued)

Variable	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
Status of women										
Currently pregnant Rural: HIV+=58; HIV-=313; Urban: HIV+=128, HIV-=182	1	1.7	4	1.3	0.56	6	4.7	4	2.2	0.32
Still has period Rural: HIV+=57; HIV-=312; Urban: HIV+=126, HIV-=182	31	54.4	89	28.5	0.0003*	69	53.9	60	33.0	0.0004*
Ever used injectable contraceptive Rural: HIV+=58; HIV-=313; Urban: HIV+=126, HIV-=182	37	63.8	187	59.7	0.61	55	43.0	63	34.6	0.13
Median number of live children Rural: HIV+=58; HIV-=308; Urban: HIV+=123, HIV-=173										
0	6	10.3	18	5.8		8	6.5	8	4.6	
1	8	13.8	37	12.0		30	24.4	25	14.5	
2-3	37	63.8	120	39		66	53.6	82	47.4	
≥4	7	12.0	133	43.2		19	15.4	58	33.6	
Breastfed Rural: HIV+=50; HIV-=289; Urban: HIV+=117, HIV-=169	44	88.0	254	87.9	0.74	86	73.5	150	88.8	0.002*
Social situation and stress										
Member of church Rural: HIV+=89; HIV-=452; Urban: HIV+=160, HIV-=240	83	93.3	444	98.2	0.01*	135	84.4	221	92.1	0.01*
Experienced stress Rural: HIV+=88; HIV-=443; Urban: HIV+=164, HIV-=244										
Never	30	34.1	148	33.4		25	15.2	31	12.7	
A few periods of stress	30	34.1	139	31.4		51	31.1	80	32.8	
Several periods of stress	20	22.7	117	26.4		33	20.1	63	25.8	
Permanent stress	8	9.1	39	8.8	0.93	55	33.5	70	28.7	0.29
Experienced during past 12 months										
Loss of job Rural: HIV+=88; HIV-=449; Urban: HIV+=164, HIV-=244	14	15.9	60	13.4	0.52	71	43.3	73	29.9	0.005*
Retirement Rural: HIV+=88; HIV-=449; Urban: HIV+=164, HIV-=244	9	10.2	46	10.2	0.99	13	7.9	16	6.6	0.59
Business failure Rural: HIV+=88; HIV-=450; Urban: HIV+=164, HIV-=244	18	20.5	79	17.6	0.51	10	6.1	16	6.6	0.85
Household break in Rural: HIV+=88; HIV-=449; Urban: HIV+=164, HIV-=244	9	10.2	34	7.6	0.40	36	22.0	52	21.3	0.87

Table 7.6: Self reported health information of rural and urban participants (continued)

Variable	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
Marital separation/ divorce Rural: HIV+=87; HIV-=450; Urban: HIV+=164, HIV-=244	6	6.9	22	4.9	0.43	10	6.1	13	5.3	0.74
Intra-family conflict Rural: HIV+=88; HIV-=447; Urban: HIV+=162, HIV-=242	19	21.6	96	21.5	0.98	43	26.5	50	20.7	0.16
Major personal injury or illness Rural: HIV+=87; HIV-=448; Urban: HIV+=164, HIV-=244	33	37.9	135	30.1	0.15	55	33.5	78	32.0	0.74
Violence Rural: HIV+=87; HIV-=448; Urban: HIV+=164, HIV-=244	24	27.6	81	18.1	0.04*	40	24.4	41	16.8	0.059
Death of a spouse Rural: HIV+=87; HIV-=449; Urban: HIV+=1644 HIV-=244	11	12.6	22	4.9	0.006*	13	7.9	12	4.9	0.21
Death or major illness of another family member Rural: HIV+=85; HIV-=449; Urban: HIV+=162, HIV-=244	42	49.4	224	49.9	0.93	109	66.5	149	61.1	0.26
Wedding of family member Rural: HIV+=87; HIV-=450; Urban: HIV+=164, HIV-=244	18	20.7	77	17.1	0.42	51	31.1	80	32.8	0.72
New job Rural: HIV+=87; HIV-=448; Urban: HIV+=164, HIV-=244	6	6.9	55	12.3	0.14	17	10.4	23	9.4	0.75
Birth in the family Rural: HIV+=87; HIV-=449; Urban: HIV+=164, HIV-=244	25	28.7	133	29.6	0.86	57	34.8	96	39.3	0.34
Separation from family Rural: HIV+=87; HIV-=449; Urban: HIV+=164, HIV-=244	4	4.6	28	6.2	0.55	43	26.2	50	20.5	0.17
Food insecurity Rural: HIV+=87; HIV-=448; Urban: HIV+=164, HIV-=244	40	46.0	157	35.0	0.05	105	64.0	145	59.4	0.34
Other major stress Rural: HIV+=89; HIV-=452; Urban: HIV+=154, HIV-=230	12	13.5	66	14.6	0.78	30	19.5	49	21.3	0.66
Felt sad, blue or depressed for two weeks or more in a row during past 12 months Rural: HIV+=87; HIV-=445; Urban: HIV+=162, HIV-=243	46	52.9	211	47.4	0.35	110	67.9	162	66.7	0.79
Willing to answer questions related to HIV/AIDS Rural: HIV+=88; HIV-=448; Urban: HIV+=164, HIV-=244	79	89.8	404	90.2		133	81.1	188	77.1	
Know people with HIV/AIDS Rural: HIV+=79; HIV-=401; Urban: HIV+=133, HIV-=188	20	25.3	107	26.7	0.80	105	79.0	137	72.9	0.21
If yes, who?										
Children Rural: HIV+=20; HIV-=107; Urban: HIV+=105, HIV-=134	0	0.0	13	12.2	0.21	21	20.0	15	11.2	0.06

Table 7.6: Self reported health information of rural and urban participants (continued)

Variable	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
Grandchildren Rural: HIV+=20; HIV-=107; Urban: HIV+=104, HIV-=134	0	0.0	2	1.9	1.0	6	5.8	4	3.0	0.33
Spouse Rural: HIV+=20; HIV-=107; Urban: HIV+=104, HIV-=134	1	5.0	0	0.0	0.15	21	20.2	4	3.0	0.0001*
Family members Rural: HIV+=18; HIV-=107; Urban: HIV+=105, HIV-=135	4	20.0	39	36.5	0.15	52	49.5	71	52.6	0.63
Friends Rural: HIV+=20; HIV-=107; Urban: HIV+=105, HIV-=136	4	20.0	18	16.8	0.75	62	59.1	64	47.1	0.06
People in community Rural: HIV+=20; HIV-=107; Urban: HIV+=105, HIV-=135	9	45.0	34	31.8	0.25	54	51.4	59	43.7	0.23
Care for orphans in household Rural: HIV+=88; HIV-=449; Urban: HIV+=161, HIV-=240	17	19.3	129	28.7	0.06	35	21.7	72	30.0	0.07

[1]p-value for difference between HIV+ and HIV- rural participants using Chi-squared or Fisher's exact test, as appropriate

[2]p-value for difference between HIV+ and HIV- urban participants using Chi-squared or Fisher's exact test, as appropriate

Overall more rural respondents reported taking medication regularly compared to urban respondents, ranging from 54.1% HIV-uninfected urban respondents to 77.5% HIV-uninfected rural respondents. Almost half of HIV-infected urban respondents took ART medication compared to only 6.5% of HIV-infected rural respondents who reported taking medication (N = 4). In both areas, significantly more HIV-uninfected participants compared to HIV-infected participants were on hypertensive medication: 72.6% vs. 45.2% in rural areas (p = 0.0001) and 68.2% vs. 24.4% in urban areas (p = 0.0001). In both groups significantly more HIV-infected participants took TB medication than their HIV-uninfected counterparts: 16.1% vs. 2.3% in rural areas (p = 0.0001) and 11.1% vs. 3.0% in urban areas (p = 0.01).

HIV-infected participants were hospitalised more often than HIV-uninfected participants. Main reasons that were reported for hospitalisation, included lung disease (especially in HIV-infected respondents), orthopaedics, maternity and TB-treatment, but none of these differences were statistically significant.

HIV-infected women were more likely not to have had any children compared to HIV-uninfected women, possibly due to HIV-infected participants being significantly younger than HIV-uninfected participants. HIV-infected urban participants were significantly younger (median age 38 years) than HIV-uninfected urban participants (median age 49 years) (p = 0.0001). HIV-uninfected women in both groups generally had more children than HIV-infected women. In urban areas, a significantly higher percentage of HIV-uninfected women reported breastfeeding (88.8%) compared to HIV-infected women (73.5%) (p = 0.002).

A high percentage of all respondents in this sample attended church. A significantly higher percentage of HIV-uninfected respondents were members of a church compared to HIV-infected respondents: 98.2% vs. 93.3% in rural areas (p = 0.01) and 92.1% vs. 84.4% in urban areas (p = 0.01). People infected with HIV living in rural areas were more likely to be members of a church (93.3%) than their HIV-infected urban counterparts (84.4%).

Experience of permanent stress was reported by a higher percentage of HIV-infected participants than HIV-uninfected participants in both groups: 9.1% vs. 8.8% in rural areas and 33.5% vs. 28.7% in urban areas. Significantly more HIV-infected urban participants reported loss of a job (43.3%) compared to HIV-uninfected participants (29.9%) ($p = 0.005$). The incidence of violence (27.6% vs. 18.1%, $p = 0.04$) and death of a spouse (12.6% vs. 4.9%, $p = 0.006$) was significantly higher in HIV-infected rural respondents compared to HIV-uninfected rural respondents. Overall, HIV-infected respondents were more likely to have experienced business failure, household break-in, marital separation or divorce, intra-family conflict, major personal injury or illness and violence. In both groups food insecurity was reported in a higher percentage of HIV-infected participants compared to HIV-uninfected participants: 46% vs. 35% in rural areas ($p = 0.05$) and 64% vs. 59.4% in urban areas ($p = 0.34$).

Overall more HIV-infected participants reported feeling sad, blue or depressed for two weeks or more in a row, with HIV-infected urban participants reporting a higher percentage (67.9%) than HIV-infected rural participants (52.9%).

Most participants were willing to answer questions related to HIV/AIDS and most urban respondents knew someone with HIV/AIDS. These included family members, friends and people in the community. In the urban group significantly more HIV-infected respondents reported having a spouse that was also HIV-infected (20.2%) compared to HIV-uninfected respondents (3%) ($p = 0.0001$). More HIV-uninfected participants also cared for orphans in the household compared to HIV-infected participants.

Health information of HIV-infected urban participants on ART and not on ART

Significantly more HIV-infected respondents on ART compared to those not on ART had experienced swelling of feet (69.8% vs. 36.4%, $p = 0.04$), blood in urine (53.5% vs. 4.1%, $p = 0.03$) and STDs (62.8% vs. 24%, $p = 0.0001$), during the past six months. However, a higher percentage of HIV-infected respondents not on ART compared to participants on ART

reported loss of appetite (53.7% vs. 23.3%; p = 0.06) and involuntary weight loss (45.5% vs. 14.0%; p = 0.36).

A slightly higher percentage of HIV-infected urban participants on ART compared to HIV-infected urban participants not on ART reported heart failure (11.6% vs. 2.5%, p = 0.02), cancer (7% vs. 0%, p = 0.01), liver disease, hepatitis and/or jaundice (16.3% vs. 4.1%, p = 0.013), as well as TB (51.2% vs. 14.9%, p = 0.0001). The family members of HIV-infected urban respondents on ART were also reported to be significantly more likely to have diabetes mellitus (53.5% vs. 24.8%, p = 0.0005), hypertension (72.1% vs. 53.7%, p = 0.03), heart disease, angina and/or heart attack (37.2% vs. 19.8%, p = 0.02), heart failure (16.3% vs. 3.3%, p = 0.007), liver disease, hepatitis and/or jaundice (14.0 vs. 4.1%, p = 0.03), HIV/AIDS (58.1% vs. 38.0%, p = 0.01) and allergies (34.9% vs. 15.7%, p = 0.01).

As expected, significantly more HIV-infected urban participants on ART reported taking medication regularly (100%) compared to HIV-infected urban participants not on ART (38.8%) (p = 0.0001). More HIV-infected urban participants not on ART, however, were hospitalised than those on treatment and main reasons for hospitalisation included lung disease, TB, gastrointestinal problems and maternity. Participants on ART were mostly hospitalised for HIV/AIDS (22.2%), maternity (22.2%) and weakness (11.1%).

A larger percentage of HIV-infected urban women on ART tended to have had more children compared to HIV-infected urban women not on ART. Women on ART were also more likely to have breastfed their infants.

Respondents on ART experienced more of the following stressors: loss of job, retirement, business failure, household break-in, marital separation or divorce, intra-family conflict, violence, death or major illness of another family member, birth in the family, separation from the family and food insecurity, with significantly more respondents on ART experiencing major personal illness or injury (48.8%) compared to those not on ART (28.1%) (p = 0.01). A

statistically significantly higher percentage of HIV-infected urban respondents on ART reported experiencing food insecurity (76.7%) compared to those not on ART (59.5%) (p = 0.04).

Fasting blood lipid results of HIV-infected and HIV-uninfected rural and urban respondents

In Table 7.7 the mean and median fasting blood lipid values of HIV-infected and HIV-uninfected rural and urban participants are summarised.

In both rural and urban areas, HIV-infected participants had significantly lower median levels for cholesterol than their HIV-uninfected counterparts (adjusted for age, rural: p = 0.001 and urban: p = 0.001), which fell within the normal range of total cholesterol (< 5.18 mmol/L). The same was found for HDL (adjusted for age, rural: p = 0.001 and urban: p = 0.001).

Table 7.7: Fasting blood lipid results of HIV-infected and HIV-uninfected rural and urban participants

Variable	HIV+						HIV-							
	N	Mean	Median	SD	Min	Max	N	Mean	Median	SD	Min	Max	p-value#	p-value*
Rural														
Cholesterol (mmol/L)	95	4.3	4.1	1.1	2.2	7.4	453	5.1	4.9	1.2	2.6	10.4	0.001*	0.001*
Triglycerides (mmol/L)	95	1.6	1.3	0.9	0.6	5.9	453	1.8	1.4	1.3	0.4	9.0	0.75	0.91
HDL (mmol/L)	95	0.9	0.8	0.5	0.1	3.3	453	1.2	1.0	0.6	0.2	4.0	0.001*	0.001*
LDL (mmol/L)	95	2.6	2.6	0.8	0.9	5.3	451	3.0	2.9	1.0	0.9	7.0	0.005*	0.004*
Urban														
Cholesterol (mmol/L)	169	3.9	3.8	1.0	1.7	6.5	248	4.4	4.4	1.1	1.4	9.0	0.001*	0.001*
Triglycerides (mmol/L)	169	1.2	1.1	0.6	0.5	4.9	248	1.4	1.2	1.0	0.4	6.9	0.18	0.4
HDL (mmol/L)	169	1.1	1.0	0.4	0.0	2.6	248	1.3	1.2	0.5	0.3	3.5	0.001*	0.001*
LDL (mmol/L)	168	2.3	2.2	0.8	0.2	4.7	242	2.5	2.5	0.9	0.7	6.2	0.002*	0.009*

#p-value for median difference between HIV+ and HIV- participants using t-tests or Mann-Whitney, as appropriate

*p-value adjusted for age

Most HIV-infected respondents (expect for HIV-infected urban participants), fell above the target for LDL that should be below 2.59 mmol/L with rural: 2.6 mmol/L vs. 2.9 mmol/L ($p = 0.005$) and urban: 2.2 mmol/L vs. 2.5 mmol/L ($p = 0.002$) compared to HIV-uninfected respondents. After adjustment for age, these differences remained significant (rural: $p = 0.004$ and urban: $p = 0.009$).

The categories of fasting blood lipids of rural and urban participants are described in Table 7.8. In rural males and urban females, lower total cholesterol levels (< 5.18 mmol/L) were significantly more prevalent in HIV-infected participants compared to HIV-uninfected participants, after adjustment for age.

In both rural and urban males a significantly higher percentage of HIV-infected participants had low HDL levels (< 1.3 mmol/L) compared to HIV-uninfected participants, after adjustment for age. In women this trend as well as that for LDL was close to significant.

Table 7.8: Prevalence of poor biochemical profile of HIV-infected and HIV-uninfected rural and urban participants

Variable	Male									Female								
	Rural					Urban				Rural					Urban			
	HIV+		HIV-			HIV+		HIV-		HIV+		HIV-			HIV+		HIV-	
	n	%	n	%	p-value[1] (p-value*)	n	%	n	%	p-value[2] (p-value*)	n	%	n	%	p-value[3] (p-value*)	n	%	n	%	p-value[4] (p-value*)
Total cholesterol																				
<5.18 mmol/L	22	88.0	49	59.8	0.008* (0.02*)	34	97.1	51	83.6	0.05 (0.08)	47	73.4	204	58.0	0.02* (0.22)	116	88.6	136	74.3	0.002* (0.04*)
≥5.18mmol/L	3	12.0	33	40.2		1	2.9	10	16.4		17	26.6	148	42.1		15	11.5	47	25.7	
Triglycerides																				
<1.7 mmol/L	18	72.0	60	73.2	0.90 (0.85)	29	82.9	48	78.7	0.62 (0.86)	40	62.5	211	59.9	0.70 (0.24)	109	83.2	145	79.2	0.37 (0.76)
≥1.7 mmol/L	7	28.0	22	26.8		6	17.1	13	21.3		24	37.5	141	40.1		22	16.8	38	20.8	
HDL																				
Women																				
<1.3 mmol/L											52	81.3	234	66.5	0.02* (0.09)	99	75.6	115	62.8	0.01* (0.05)
≥1.3 mmol/L											12	18.8	118	33.5		32	24.4	68	37.2	
Men																				
<1.0 mmol/L	19	76.0	22	26.8	0.001* (0.001*)	20	57.2	18	29.5	0.007* (0.008*)										
≥1.0 mmol/L	6	24.0	60	73.2		15	42.9	43	70.5											
LDL																				
<2.59 mmol/L	10	40.0	34	41.5	0.89 (0.97)	28	80.0	41	68.3	0.21 (0.27)	32	50.0	116	33.1	0.09 (0.05)	82	63.1	84	47.2	0.005* (0.09)
≥2.59 mmol/L	15	60.0	48	58.5		7	20.0	19	31.7		32	50.0	234	66.9		48	36.9	94	52.8	

[1]p-value for difference between HIV+ and HIV- rural male participants using Chi-squared or Fisher's exact test, as appropriate

[2]p-value for difference between HIV+ and HIV- urban male participants using Chi-squared or Fisher's exact test, as appropriate

[3]p-value for difference between HIV+ and HIV- rural female participants using Chi-squared or Fisher's exact test, as appropriate

[4]p-value for difference between HIV+ and HIV- urban female participants using Chi-squared or Fisher's exact test, as appropriate

*p-value adjusted for age

Fasting blood lipid results of HIV-infected urban respondents on ART and not on ART

In urban areas, median levels for cholesterol (4.1 mmol/L vs. 3.7 mmol/L; p = 0.01), triglycerides (1.3 mmol/L vs. 1.0 mmol/L; p = 0.02) and HDL (1.1 mmol/L vs. 1.0 mmol/L; p = 0.008) were significantly higher in respondents on ART than in HIV-infected respondents not using ART.

A higher percentage of males on ART had high levels of triglycerides compared to males not on ART (30.0% vs. 12.0%), but the difference was not statistically significant. A higher percentage of females on ART had high levels of cholesterol (18.8% vs. 9.1%), triglycerides (28.1% vs. 13.1%), and LDL (48.4% vs. 33.3%) compared to females not on ART, but differences were not statistically significant.

Biochemical parameters of HIV-infected and HIV-uninfected rural and urban participants

Table 7.9 reflects biochemical parameters of HIV-infected and HIV-uninfected rural and urban respondents. Median fasting glucose levels were significantly higher in HIV-uninfected respondents than their HIV-infected counterparts (adjusted for age, rural: p = 0.003 and urban: p = 0.002), but still within the target of < 5.6 mmol/L. A similar trend was found for fibrinogen levels for HIV-uninfected participants compared to HIV-infected participants (adjusted for age, rural: p = 0.06 and urban: p = 0.004), and fell in the normal range of 1.5 – 4 g/L, expect for HIV-uninfected urban respondents (4.1 g/L). Median HbA1c levels were significantly higher in HIV-uninfected urban respondents than their HIV-infected counterparts (adjusted foir age, p = 0.01), but still below the target of < 6.5%, indicating that these differences do not have much clinical significance.

Table 7.9: Biochemical parameters of HIV-infected and HIV-uninfected rural and urban respondents

Variable	HIV+						HIV-							
	N	Mean	Median	SD	Min	Max	N	Mean	Median	SD	Min	Max	p-value[#]	p-value*
Rural														
HbA1c (%)	97	5.5	5.4	0.5	4.6	8.5	470	5.8	5.5	1.5	3.1	13.7	0.12	0.12
Fasting Glucose (mmol/L)	96	4.8	4.7	0.7	3.4	7.5	469	5.7	5.1	2.5	3.4	21.1	0.001*	0.003*
CD4 (mm^3)	97	404.3	330.0	274.8	30.0	1270.0								
Fibrinogen (g/L)	94	3.4	3.3	0.9	1.9	5.5	445	3.8	3.7	1.0	0.6	7.7	0.006*	0.06*
Urban														
HbA1c (%)	170	5.5	5.4	0.4	4.3	7.7	250	5.8	5.5	1.2	4.4	13.0	0.002*	0.01*
Fasting Glucose (mmol/L)	169	4.7	4.6	0.6	3.4	6.4	247	5.3	4.9	1.6	3.3	15.8	0.001*	0.002*
CD4 (mm^3)	171	346.1	287.0	250.6	25.0	1586.0								
Fibrinogen (g/L)	162	3.8	3.6	1.0	2.1	8.2	232	4.1	4.1	0.9	1.3	6.5	0.001*	0.004*

[#]p-value for median difference between HIV+ and HIV- participants using Chi-squared or Fisher's exact test, as appropriate

*p-value adjusted for age

Table 7.10 indicates the blood pressure of HIV-infected and HIV-uninfected rural and urban participants.

Table 7.10: Blood pressure of HIV-infected and HIV-uninfected rural and urban participants

Blood pressure (BP)	Rural					Urban				
	HIV+		HIV-			HIV+		HIV-		
	n	%	n	%	p-value[1]	n	%	n	%	p-value[2]
Normotensive	25	26.6	78	17.2	0.001*	67	40.6	52	21.1	0.03*
Hypertensive	69	73.4	375	82.8	0.68	98	59.4	194	78.9	0.02*

[1]p-value for difference between HIV+ and HIV- rural participants using Chi-squared or Fisher's exact test, as appropriate

[2]p-value for difference between HIV+ and HIV- urban participants using Chi-squared or Fisher's exact test, as appropriate

After adjustment for age, significantly more urban HIV-uninfected participants had high blood pressure (systolic BP $\geq$ 140 mmHg and/or diastolic BP $\geq$ 90 mmHg) than urban HIV-infected participants (odds ratio 1.7, 95% CI 1.1; 2.8)

Biochemical parameters of HIV-infected urban participants on ART and not on ART

The median HbA1c, fasting glucose, CD4 count and fibrinogen were more or less the same for HIV-infected urban participants on ART and HIV-infected urban participants not on ART. Those on ART had slightly higher fasting median glucose values (4.7 mmol/L vs. 4.6 mmol/L), while ART-naïve participants had higher fibrinogen levels (3.7 g/L) compared to those on ART (3.4 g/L), but both were still in the normal range.

No significant difference in the percentage of HIV-infected urban respondents on ART and not on ART was found.

Association of reported health factors and HIV status

In addition to descriptive comparisons between HIV-infected and HIV-uninfected participants, logistic regression was used to identify significant health factors associated with HIV.

Health factors associated with HIV status in rural participants

The following health variables were considered for inclusion:

History of alcohol use, loose stools/diarrhoea for at least 3 days in last 6 months, involuntary weight loss > 3kg in last 6 months, ever diagnosed with TB, family member diagnosed with TB, TB treatment, member of a church, experienced violence in last 12 months, experienced death of spouse during past 12 months, experienced unavailability of food/food insecurity during past 12 months, care for orphans in household (all as yes vs. no).

The following variables were selected in the model: age, ever diagnosed with TB, TB treatment, experienced death of spouse, involuntary weight loss, member of a church with odds ratios as indicated in Table 7.11.

Table 7.11: Health factors associated with HIV status (rural)

Variable		Odds ratio (95% CI)	p-value
Age		0.92 (0.89; 0.95)	<0.0001
Involuntary weight loss > 3kg in last 6 months	yes vs. no	1.86 (1.08; 3.20)	0.0255
Ever diagnosed with TB	yes vs. no	2.50 (1.18; 5.23)	0. 0163
TB treatment	yes vs. no	3.29 (1.00; 10.80)	0.0498
Member of a church	yes vs. no	0.22 (0.06; 0.76)	0. 0167
Experienced death of spouse during past 12 months	yes vs. no	4.91 (2.06; 11.73)	0.0003

In this rural sample, for every year that age increased the odds of having HIV decreased (by 8%). As far as health factors in this sample were concerned, HIV-infection was positively associated with losing weight involuntarily (> 3kg in the past 6 months) (odds ratio 1.86), ever being diagnosed with TB (odds ratio 2.50), being on TB treatment (odds ratio 3.29) and having experienced death of a spouse during the past year (odds ratio 4.91). Church membership was negatively associated with HIV-infection (odds ratio 0.22).

Health factors associated with HIV status in urban participants

The following health variables were considered for inclusion:

Loose stools/diarrhoea for at least 3 days in last 6 months, loss of appetite in last 6 months, involuntary weight loss > 3kg in last 6 months, ever diagnosed with TB, TB treatment, member of a church, experienced loss of job in last 12 months, experienced violence in last 12 months, experienced separation of family in last 12 months, care for orphans in household (all as yes vs. no).

The following variables were selected in the model: age, ever diagnosed with TB, loose stools/diarrhoea for at least 3 days in last 6 months and member of a church with odds ratios as indicated in Table 7.12.

Table 7.12: Health factors associated with HIV status (urban)

Variable		Odds ratio (95% CI)	p-value
Age		0.93 (0.91; 0.95)	<0.0001
Loose stools diarrhoea for at least 3 days in last 6 months	yes vs. no	2.04 (1.23; 3.41)	0.0061
Ever diagnosed with TB	yes vs. no	2.49 (1.37; 4.53)	0. 0028
Member of a church	yes vs. no	0.46 (0.23; 0.91)	0. 0276

In this urban sample, for every year that age increased, the odds of having HIV decreased (by 7%). As far as health factors were concerned, HIV-infection was positively associated with having diarrhoea for at least 3 days in the past 6 months (odds ratio 2.04) and ever being diagnosed with TB (odds ratio 2.49). As in the rural sample, church membership was negatively associated with HIV-infection (odds ratio 0.46).

DISCUSSION

Reported health information

In sub-Saharan Africa, the HIV/AIDS-epidemic has traditionally concentrated in urban areas, where significantly higher HIV-prevalence rates have been recorded than in rural areas (Van Donk, 2006). In the current study HIV/AIDS-prevalence was also much higher in urban areas than in rural areas. Possible reasons may include a positive correlation between HIV/AIDS and the level of urbanisation in South Africa, a higher percentage of younger people living in urban areas, poor living conditions (including a lack of food security) and gender relations (Van Donk, 2006).

In the present study a slightly higher percentage of HIV-infected rural and urban respondents smoked, when compared to HIV-uninfected participants in both areas. HIV-infected rural respondents tended to start smoking at a younger age compared to HIV-uninfected respondents, while HIV-infected urban respondents tended to smoke slightly more than HIV-uninfected urban

respondents. Cigarette smoking accounts for a large burden of preventable disease in South Africa (Groenewald *et al.*, 2007) and may present unique health risks in the context of HIV, by increasing receptiveness to HIV or other infections, by altering the course of HIV-infection itself, or by changing the risk of smoking-related chronic diseases (Webb *et al.,* 2007).

Alcohol use is prevalent among HIV-infected individuals and is associated with non-adherence in numerous studies (Brigido *et al.*, 2001; Cook *et al.*, 2001; Eldred *et al.*, 1998; Sankar *et al.*, 2007).
In both groups a higher percentage HIV-infected participants used alcohol compared to HIV-uninfected participants, but the differences were not statistically significant. Beer and homemade beer were the most popular alcoholic beverages.

Lifestyle factors such as tobacco smoking, use of snuff and alcohol intake also impact on quality of life need to be considered in HIV-infected people. According to the 2011 World Health Organisation (WHO) report on global tobacco use, tobacco smoking contributes to nearly six million deaths worldwide each year, with low and middle-income countries more at risk (WHO, 2011). Individuals who are HIV-infected are known to have a higher tobacco smoking prevalence than the general population (Saves *et al.,* 2003; Stall *et al.,* 1999). One of the most consistent findings in a review done by Marshall *et al.* (2009) in Baltimore, United States of America, was that in HIV-infected people, cigarette smoking was associated with increased respiratory infections, particularly pneumocystis pneumonia and bacterial pneumonia. Alcohol consumption is another important risk factor for burden of disease and social destruction worldwide (Rehm *et al.,* 2004; Rehm *et al.,* 2003). Although alcohol does not play a role in the biological pathway, it seems to be a mediating factor in risky sexual behaviour and therefore impacts on the transmission of HIV (Mbulaiteye *et al.,* 2000). In addition, heavy drinking may lead to people on treatment not taking their medication properly (Talbot *et al.,* 2002).

A study in South Africa found a 35% rate of depression and a 15% rate of post-traumatic stress disorder among men and women with HIV-infection (Olley *et al.,* 2004). Similarly, a study with AIDS patients in South Africa found significantly higher rates of depression and anxiety in HIV-infected individuals (33%) than in HIV-uninfected individuals (24%). In addition, another study found higher

levels of anxiety among an HIV-infected group in South Africa, relative to a non-infected group (Mfusi and Mahabeer, 2000).

Nutritional alterations are common in HIV-infection (Kotler, 2000). Clinically, malnutrition develops as a result of either starvation or cachexia. In the current study, HIV-infection was positively associated with losing weight involuntarily (more than three kilogram in the past six months) (rural) and having diarrhoea for at least three days in the past six months (urban). Significantly more HIV-infected participants in all groups reported experiencing loose stools and diarrhoea, involuntary weight loss of more than three kilograms, as well as STDs compared to HIV-uninfected participants, and therefore at risk to develop malnutrition. In addition, significantly more HIV-infected participants in urban areas reported loss of appetite and skin rash than their HIV-uninfected counterparts.

Noncommunicable diseases are the leading causes of death globally, killing more people each year than all other causes combined (WHO, 2010). The presence of comorbidities such as heart disease, diabetes mellitus, hepatitis, and opportunistic infections may complicate the profile of the HIV-infected patient on ART (Dong and Imai, 2012:873). Chronic lifestyle diseases share similar risk factors, including tobacco smoking, diabetes mellitus, hypertension, obesity, hyperlipidemia and physical inactivity (Van Zyl *et al.*, 2012).

In rural and urban groups, a larger percentage of HIV-uninfected participants reported having diabetes mellitus. The younger mean age of HIV-infected participants should be kept in mind here, since weight gain is often the result of aging. Abnormalities in glucose metabolism have been reported before treatment with HAART became the standard of care for HIV-patients. Studies reviewed by Salas-Salvadó and Garcia-Lorda (2001) showed that glucose levels may be normal or lower than normal, insulin levels may be normal or increased, while insulin sensitivity is increased in patients not receiving HAART. In a South African study, of black females living in Mangaung and not on any current treatment for HIV-infection, the majority of HIV-infected women had normal serum glucose levels and no significant differences were detected between HIV-infected and uninfected groups (Hattingh *et al.*, 2009). These results were similar to those reported for black

South Africans in the THUSA study (Vorster *et al.*, 2004) and support the thinking that HIV-infected ART-naïve individuals may maintain normal serum glucose levels (Salas-Salvadó and Garcia-Lorda, 2001). Adverse effects of treatment and the probability that patients on ART were in a more advanced stage of HIV (and thus qualified for treatment) may have resulted in initial weight loss and therefore long-term side-effects, such as diabetes mellitus, had not presented in this sample yet.

HIV-infected urban participants were significantly more likely to have liver disease, hepatitis and/or jaundice than HIV-uninfected urban participants possibly as a result of HIV-itself and opportunistic infections that occur more commonly in HIV-infected patients.

In the current study, significantly more HIV-uninfected urban participants had high blood pressure results than HIV-infected urban participants. A possible contributing factor is that HIV-uninfected participants were significantly older than HIV-infected participants and hypertension is often associated with increasing age. HIV-participants were also more likely to have a lower body mass index (BMI), which also has an impact on BP. Major lifestyle modifications have been shown lower BP and include weight reduction in those individuals who are overweight or obese (He *et al.*, 2000). A health survey in 2010 amongst adults in a rural area in South Africa investigated factors associated with hypertension and excess weight, while also looking at HIV-infection and ART status (Malaza *et al.*, 2012). Prevalence of hypertension differed between HIV-infected (of which some were on ART) and HIV-uninfected individuals with HIV-uninfected women being significantly more likely to be hypertensive than HIV-infected women (possibly due to lower weight of HIV-infected women), while there was no association of hypertension with HIV status among men.

In 2010, 8.8 million people acquired active TB worldwide, of which 1.1 million were living with HIV (WHO, 2010). TB remains the leading cause of death among people living with HIV. TB is one of the most commonly notable diseases in South Africa, and more than 80% of people living with HIV and TB live in sub-Saharan Africa (WHO, 2010). The global burden of TB is increasing, largely due to the spread of HIV/AIDS (ASSAf, 2007:35), but these statistics are also affected by other contributing factors such as overcrowding, poverty, unemployment and malnutrition (ASSAf, 2007:34). In this

study, a positive association was found between HIV-infection and ever having been diagnosed with TB (rural and urban) or being on TB treatment (rural). In both groups, significantly more HIV-infected respondents had TB compared to HIV-uninfected respondents. Results from the logistic regression confirmed that HIV-infection was positively associated with a history of TB diagnosis (rural and urban sample) as well as TB treatment (rural). South Africa has a high TB-HIV co-infection rate of 73%, yet only 46% of TB patients are tested for HIV (Heunis *et al.,* 2011).

In this study, being a member of a church was negatively associated with HIV-infection in both rural and urban samples. This could be ascribed to the support (both social and moral) offered in church groups. This support, which often includes food assistance, makes it less likely that these participants would turn to other ways of obtaining food or money such as transactional sex.

In the present study, a higher percentage of HIV-infected respondents reported experiencing permanent stress than HIV-uninfected participants in both groups, but especially in urban areas. In the rural sample, HIV-infection was positively associated with experiencing death of a spouse during the past year. Tromble-Hoke *et al.* (2005) studied HIV-infected men in South Eastern United States in order to determine whether severe stress events and more frequent use of stress management behaviours were associated with more desirable nutrition-related parameters. They found that men with more severe stress events were more likely to experience adverse symptoms that could negatively influence nutritional health (Scott-Sheldon *et al.,* 2008). In this study major stressors included loss of job, personal injury or illness, death or illness of another family member and food insecurity.

In the present study, a higher percentage of HIV-uninfected participants in rural and urban areas, cared for orphans. The 2003 South African Demographic and Health Survey (SADHS) is the second National health survey to be conducted by the Department of Health (DoH), following the first in 1998. As reported in the SADHS (2003:13), one of the possible reasons for more households taking care of another's child, could relate to the practice among some mothers of sending their children to the children's grandmother for care to enable the mothers to engage in the formal labour market. It may also relate to the increased numbers of deaths of young men and women over the

past few years. This is confirmed by the finding that of those children living with neither parent, 0.8% in 1998 vs. 2.4% in 2003 had lost both parents to death (SADHS, 2003:13).

Biochemical profile

Studies reviewed by Salas-Salvodó and Garcia-Lorda (2001) and Gramlich and Mascioli (1995) showed that the metabolism of lipids may change during HIV-infection and AIDS, unrelated to the use of ARTs. The THUSA study found that HDL-cholesterol and total cholesterol, hemoglobin, albumin and triglycerides were significantly lower in infected subjects (Vorster *et al.,* 2004). In the study performed by Hattingh *et al*, (2009), amongst black females living in Mangaung and not on any current treatment for HIV-infection, the researches found that older (35-44 years) HIV-infected women had significantly lower median total serum cholesterol values than older HIV-uninfected women.

In the current study median levels for cholesterol, triglycerides, HDL and LDL were higher in respondents on ART than in HIV-infected respondents not using ART, but these differences were not statistically significant. The biochemical abnormalities in patients receiving HAART can include hyperlipidemia (specifically high triglycerides and LDL-cholesterol and low HDL-cholesterol) and insulin resistance (Joy *et al.,* 2008). A higher percentage of males and females in the current study on ART had high levels of cholesterol, triglycerides and LDL and low levels of HDL compared to respondents not on ART. Since the late 1990s, various reports have described insulin and carbohydrate metabolism abnormalities in HIV-patients receiving HAART (Salomon *et al.,* 2002; Salas-Salvadó and García-Lorda, 2001) and studies have shown a rise rather than a fall in serum triglycerides once ART has begun (Salas-Salvadó and García-Lorda, 2001).

In the current study median HbA1c and fasting glucose were slightly lower in HIV-infected respondents than their HIV-uninfected counterparts. Participants on ART also had slightly higher fasting median glucose values and ART-naïve participants had higher fibrinogen levels (which may be related to inflammation) compared to those on ART treatment, but these differences were not statistically significant.

Metabolic alterations and changes in body composition are increasingly evident in patients receiving HAART (Carr, 2008). Peripheral lipoatrophy (loss of body fat) (Bergersen, 2006), increased visceral fat, increased triglycerides, increased total cholesterol and insulin resistance (Joy *et al.,* 2008) and hypertension (Hadigan *et al.,* 2001) are common among HIV-infected men and women on treatment. HIV-associated lipodystrophy syndrome refers to the metabolic abnormalities and body shape changes seen in patients with HIV (Dong and Imai, 2012:878). As previously mentioned, lipid abnormalities, now often characteristically seen in HIV-infected patients on HAART, include elevated triglycerides, elevated total cholesterol and HDL-cholesterol (Bader and Kelly, 2008). Total cholesterol levels may be normal or reduced, while triglycerides levels may increase in HIV-infection (Salas-Salvadó and Garcia-Lorda, 2001). Hypertension remains the most important risk factor for stroke (Alberti *et al.*, 2009). In countries with a high prevalence of HIV-infection, it is still largely unknown how increased ART has affected the prevalence of overweight, obesity, and hypertension (Malaza *et al.*, 2012).

As found in this study, the results of a study performed by Hattingh *et al.* (2009), also reported that median plasma fibrinogen concentrations were lower in HIV-infected women than in HIV-uninfected women. This may be ascribed to the fact that BMI was significantly lower in the younger (25-34 years) HIV-infected women compared to older HIV-infected women (35-44 years), however both under- and overnutrition seem to be associated with increased fibrinogen levels (Coors *et al.,* 2001). In the THUSA study, high fibrinogen concentrations were found in both HIV-uninfected and HIV-infected men and women, and HIV-infection showed no significant influence on fibrinogen levels (James *et al.,* 2000). Participants included in this study included both healthy and ill participants, whereas the THUSA study only included apparently healthy subjects.

We acknowledge there is a certain degree of bias regarding the age of rural volunteers in the study. Older and unemployed individuals were more likely to participate. More women than men participated in the study probably due to men being labourers and formally employed and therefore not available for interviews conducted during the day. It is also possible that ill persons may have been more likely to participate in the study where medical examinations were conducted

due to limited health services, especially in rural areas. Due to these reasons, the authors acknowledge that the study group is probably not representative of the general population.

As mentioned before, another limitation is that patients were grouped into the two groups comparing urban participants on ART and not on ART, based on report of medication use. No indication of duration of ART was, however, indicated.

CONCLUSIONS

The younger age and lower BMI of HIV-infected participants make it difficult to compare the health indicators of these participants to those of HIV-uninfected participants. Despite this, HIV-infection was positively associated with diarrhoea (urban) or involuntary weight loss (rural), both of which are outcomes of HIV-infection. In both samples, a history of TB (rural and urban), or TB treatment (rural) were positively associated with HIV-infection. Being a member of a church was negatively associated with HIV-infection in both rural and urban samples.

The younger age and lower BMI of HIV-infected participants confirms the higher prevalence of opportunistic infections and the associated symptoms (such as diarrhoea and weight loss) in HIV-infected persons that are reported in the literature.

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CHAPTER 8

Nutritional Factors associated with HIV status in Rural and Urban Communities in the Free State, South Africa

ABSTRACT

Nutritional factors can be described as those directly related to food and nutrition (such as reduced food intake) and those indirectly related to food and nutrition (such as poverty and food insecurity). The objective of this study was to determine significant independent nutritional factors associated with HIV in rural and urban communities in the Assuring Health for All (AHA) study. The AHA study was undertaken in rural Trompsburg, Philippolis and Springfontein (2007) and urban Mangaung (2009).

Adults between 25-64 years were eligible to participate. Of the 567 rural participants, 97 (17.1%) were HIV-infected. Of the 424 urban participants, 172 (40.6%) were HIV-infected.

Logistic regression with forward selection ($p < 0.05$) was used to select significant independent socio-demography, household food security, dietary diversity, physical activity anthropometry and reported health factors associated with HIV status. Variables with a p-value of < 0.15 were considered for inclusion in the model.

In this sample, the odds of having HIV-infection decreased as age increased. In rural areas, HIV-infection was negatively associated with microwave oven ownership (odds ratio 0.20, 95% CI 0.07; 0.57) and being married (odds ratio 0.17, 95% CI 0.08; 0.36). HIV-infection was positively associated with spending less than R50 per week on food (odds ratio 3.15, 95% CI 1.43; 6.95); having a body fat percentage of < 5% versus 25%+ (odds ratio 4.41, 95% CI 1.69; 11.51) or having been diagnosed with tuberculosis (odds ratio 3.81, 95% CI 1.93; 7.52). In the urban sample, HIV-infection was negatively associated when a person was male (odds ratio 0.29, 95% CI 0.15; 0.57). HIV-infection was positively associated with experiencing periods of food shortage (odds ratio 2.34, 95% CI 1.26; 4.37) and having a body fat percentage of < 15% versus 25%+ (odds ratio 8.62, 95% CI 4.42; 16.84).

Indicators related to wasting, previous tuberculosis and a lower socio-economic status are associated with HIV-infection, either as outcomes of the disease or as exposures. A vicious cycle develops, with poverty increasing the likelihood of contracting HIV/AIDS and HIV/AIDS contributing to poverty.

INTRODUCTION

Nutritional status is a major factor in survival of HIV-infected patients (Kennedy and MacIntyre, 2003). Poor nutrition and food insecurity contribute to the deterioration of the health of HIV-

infected patients and ultimately leads to increased mortality (Spencer *et al.*, 2007; Fawzi, *et al.*, 2005).

The relationship between Human Immunodeficiency Virus (HIV)/Acquired Immune Deficiency Syndrome (AIDS), malnutrition and wasting is well described. Nutritional status is compromised of various factors including those directly related to food and nutrition such as reduced food intake, malabsorption, increased nutritional requirements and increased nutrient losses (Kennedy and MacIntyre, 2003; Earthman, 2004; Fawzi *et al.*, 2005), as well as those factors indirectly related to food and nutrition, such as socio-demographic conditions, physical activity, opportunistic infections and medication-related side-effects. Each of these, alone and in combination, contribute to nutritional risk. This study formed part of the baseline phase of the Assuring Health for All in the Free State (AHA-FS) study which aims to determine how living in rural and urban communities can influence lifestyle and health. The aim of this sub-study was to determine significant independent nutritional factors associated with HIV in rural and urban communities in the Free State.

METHODOLOGY

The Ethics Committee of Faculty of Health Sciences, University of the Free State (UFS) approved the study (ETOVS 21/07). The main rural study was performed in 2007 in three rural Free State areas, namely Trompsburg, Philippolis and Springfontein, and the urban study in 2009 in Mangaung. A cross-sectional study was undertaken. In rural areas all households in the black and coloured townships were eligible to participate. In urban Mangaung a stratified proportional cluster sample was selected to sample one hundred starting points from which adjacent households were approached. All adults between 25-64 years that gave informed consent were eligible to participate. On days of data collection, blood and urine samples were collected, a medical examination was performed by medical practitioners and anthropometric measurements were taken. Thereafter, questionnaires related to socio-demography; household food security; dietary diversity; physical activity; and reported health were completed in structured interviews with trained students.

The variables selected in the final model considered for inclusion in the final model for this sub-study included: socio-demographic and household information (employment status; marital status; type of dwelling; water and sanitary conditions; assets; household income; and the proportion of income spent on food); household food security information (information related to agriculture, crop and livestock ownership; the distribution of food between household members; the degree of hunger in the household; and the coping strategies implemented by households in times when experiencing food insecurity); dietary intake information [dietary diversity score (DDS) was calculated from twelve possible food groups to classify dietary diversity as low ($\leq$ 3), medium (4 and 5) or high ($\geq$ 6) [Food and Agriculture Organisation (FAO), 2003)]; physical activity information [physical activity levels (PAL) were classified as sedentary (1-1.39 PAL), low active (1.4-1.59 PAL), active (1.6-1.89 PAL) and very active (1.9-2.5 PAL)]; anthropometric information [height, weight, waist circumference (WC), mid-upper-arm-circumference (MUAC) and six skinfold thickness measurements, including triceps, biceps, supra-iliac, subscapular, thigh and calf]; reported health (social support; tobacco and alcohol consumption patterns; medical history and medications; family medical history; levels of stress and behaviours related to the control of stress) and medical examination information (heart rate, visible signs, cardiovascular abnormalities, respiratory abnormalities, abdominal pathology, nervous system abnormalities, skin pathology and HIV pre-test counselling).

Logistic regression with forward selection ($p < 0.05$) was used to select significant independent factors associated with HIV.

RESULTS

Of the 570 rural participants, 567 had HIV results. Of these 567, 97 (17.1%) were HIV-infected. Of the 426 urban participants, 424 had HIV results. Of these 424, 172 (40.6%) were HIV-infected. HIV-infected participants were significantly younger (median age in rural 40.5 years; and 38 years in urban) than HIV-uninfected participants (median age in rural 51 years; and 49 years in urban) (rural: $p = 0.001$ and urban: $p=0.0001$).

For the rural and urban areas, the variables selected into the final model are indicated in the Table 8.1.

Table 8.1: Final model of factors associated with HIV status in rural and urban areas

Variable		Odds ratio (95% CI)	p-value
Rural			
Age		0.91 (0.89; 0.94)	<0.0001
Marital status	married vs. not	0.17 (0.08; 0.36)	<0.0001
Microwave	yes vs. no	0.20 (0.07; 0.57)	0.0027
Money spent on food	up to R50 vs. R101+ R51-R100 vs. R101+	3.15 (1.43; 6.95) 1.37 (0.75; 2.51)	0.0172
Ever diagnosed with TB	Yes vs. no	3.81 (1.93; 7.52)	0.0001
Body fat	<5% vs. 25%+ 6-15% vs. 25%+ 16-24% vs. 25%+	4.41 (1.69; 11.51) 3.60 (1.64; 7.88) 3.19 (1.60; 6.39)	0.0011
Urban			
Age		0.92 (0.90; 0.95)	<0.0001
Gender	male vs. female	0.29 (0.15; 0.57)	0.0002
Periods of food shortage	yes vs. no	2.34 (1.26; 4.37)	0.0075
Body fat	<15% vs. 25%+ 16-24% vs. 25%+	8.62 (4.42; 16.84) 3.02 (1.56; 5.83)	<0.0001

In this rural sample, for every year that age increased the odds of having HIV decreased (by 9%). As far as socio-demographic and food security indicators were concerned, HIV-infection was negatively associated with having a microwave oven (odds ratio 0.20) and being married (odds ratio 0.17). On the other hand, HIV-infection was positively associated with spending less than R50 on food per week (odds ratio 3.15) or spending less than R50 to R100 on food per week vs. > R101 (odds ratio 1.37). As far as body fat percentages in the rural sample were concerned, a positive association was found between HIV-infection and having a body fat percentage of < 5% versus (vs.) 25%+ (odds ratio 4.41). A positive association between HIV-infection was also found in rural participants with a body fat percentage of 6-15% vs. 25+ (odds ratio 3.60) and between 16-24% vs.

25+ (odds ratio 3.19). As far as health factors in this sample were concerned, HIV-infection was positively associated with ever being diagnosed with tuberculosis (TB) (odds ratio 3.81).

In this urban sample, for every year that age increased the odds of having HIV decreased (by 8%). As far as socio-demographic and food security indicators were concerned, HIV-infection was negatively associated with male gender (odds ratio 0.29). On the other hand, HIV-infection was positively associated with experiencing periods of food shortage (odds ratio 2.34). In terms of body fat percentages in the urban sample, HIV-infection was positively associated with having a body fat percentage of < 15% vs. 25%+ (odds ratio 8.62) and between 16-24% vs. 25+ (odds ratio 3.02).

DISCUSSION

In both rural and urban areas, the odds of having HIV decreased as age increased. This is consistent with the results of a national South African community-based survey that showed that HIV-prevalence peaks in women aged 20-29 years and men aged 30-39 years (Connolly *et al*., 2004), and decreases steadily thereafter. In addition to older age, HIV-infection was negatively associated with being married than being unmarried in rural areas, probably due to married participants having fewer sexual partners. In the urban sample, HIV-infection was also associated with gender, with males being less likely to have HIV than females. Female and single-headed households, illiteracy and unemployment predispose to poverty and food insecurity (Bawadi *et al.,* 2012; Riley *et al.,* 2012; Labadarios *et al.,* 2011), which in turn predisposed to HIV (Ivers and Cullen, 2011). According to United States Agency for International Development (USAID) (2006), most-at-risk populations (such as women in urban areas) engage in behaviours that put them at higher risk for HIV-infection (USAID, 2006), such as sexual favours for food or money [World Health Organisation (WHO), 2009; Oyefara, 2007].

In rural areas, ownership of a microwave oven was negatively associated with HIV-infection, which probably indicates a higher socio-economic status. This concurs with the finding in rural areas that the smaller the amount of money spent on food, the higher the likelihood of having HIV. In urban

areas, HIV-infection was positively associated when the household experienced periods of food shortage, also related to a lower socio-economic status and poverty. As reported in other studies (Kaschula, 2011; Bachmann and Booysen, 2003), HIV-infected persons in both rural and urban areas in the current study were generally poorer and had a higher level of food insecurity than HIV-uninfected persons. A vicious cycle develops, with poverty exacerbating the spread of HIV/AIDS; and conversely, HIV/AIDS contributing to poverty (Lange and Van Der Waals, 2002). According to Academy of Science of South Africa (ASSAf) (2007:25-26), poverty is associated with unemployment, inability to pay for food, healthcare and basic services, vulnerability, homelessness and despair (ASSAf, 2007:25-16). Sufficient income is necessary to ensure that enough food can be obtained to meet the requirements of a household and therefore income is an important determinant of a household's ability to meet food security needs (Hendriks, 2005; Coutsoudis *et al.*, 2000).

In rural areas a previous diagnosis of TB was positively associated with HIV-infection. HIV and TB co-infection remains a serious challenge (WHO, 2010) with TB remaining the leading cause of death among people living with HIV (Mugusi *et al.*, 2009). More than 80% of people living with HIV and TB live in sub-Saharan Africa (WHO, 2010), where they are often exposed to factors such as overcrowding, poverty, unemployment and malnutrition (ASSAf, 2007:34).

In both rural and urban areas, a lower body fat percentage was consistently associated with HIV-infection. Percentage fat is a good indicator of wasting (Shen *et al.,* 2006) and when a person is infected with HIV, weight loss and loss of body cell mass often result, becoming strong predictors of poor prognosis (ASSAf, 2007:141).

We acknowledge there is a certain degree of bias regarding the age of rural volunteers in the study. Older and unemployed individuals (more females than men) were more likely to participate. It is also possible that ill persons may have been more likely to participate in the study where medical examinations were conducted, due to limited health services, especially in rural areas. Due to these reasons, the authors acknowledge that the study group is probably not representative of the general population.

CONCLUSIONS

Indicators related to wasting (low fat percentage) and a history of TB were positively associated with HIV-infection, probably as outcomes of the disease. In addition, indicators of a lower socio-economic status [such as being female (urban), unmarried (rural), spending very little on food (rural) and food shortage (urban)], were positively associated with HIV-infection. A vicious cycle develops, with poverty increasing the likelihood of contracting HIV/AIDS, and HIV/AIDS contributing to poverty.

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CHAPTER 9

CONCLUSIONS AND RECOMMENDATIONS

9.1 INTRODUCTION

Nutritional factors can be described as those directly related to food and nutrition (such as reduced food intake) and those indirectly related to food and nutrition (such as poverty and food insecurity).

The objective of this study was to determine significant independent nutritional factors associated with HIV status in rural and urban communities in the Assuring Health for All (AHA) study.

9.2 CONCLUSIONS

The following conclusions evolved from the study:

9.2.1 Socio-demographic characteristics and household food security

In rural and urban communities, HIV-infected participants were significantly younger and less likely to be married than HIV-uninfected participants. In the urban sample, statistically more HIV-infected respondents were unemployed than HIV-uninfected respondents, whereas in rural areas, significantly more HIV-infected persons had a lower income than their counterparts.

As far as household amenities are concerned, a significantly higher percentage of HIV-uninfected rural respondents had a refrigerator and/or freezer; microwave; and television compared to HIV-infected rural respondents. In all areas, significantly more HIV-infected respondents spent less money on food and reported that their children complained of hunger due to limited food in the house, compared to HIV-uninfected participants.

In urban areas, significantly more HIV-infected respondents ran out of money to buy food; had to rely on limited number of food to feed their children; and had to send their children to bed hungry due to limited money to buy food. HIV-infected urban participants on ART were more likely to stay in an overcrowded home; not to have their own tap; and were more likely to be casually employed than their counterparts not on ART, differences that were statistically significant.

HIV-infected persons in both rural and urban areas were generally poorer and had a high level of food insecurity. HIV-infection was positively associated with indicators of lower socio-economic status, such as not having a microwave oven, limited access to vegetables, limited amount of money to buy food and experiencing periods of food shortage.

9.2.2 Dietary diversity and physical activity

Significantly more HIV-infected rural respondents ate eggs and sweets compared to HIV-uninfected rural participants, while HIV-infected urban participants on ART were also more likely to usually consume eggs than HIV-infected urban participants not on ART. A higher percentage of HIV-infected urban participants tended to have a low DDS when compared to HIV-infected rural participants, but the difference was not significant. A large percentage of all participants had medium to low DDS, but no significant differences in the DDSs of HIV-infected and HIV-uninfected participants occurred in rural and urban areas. HIV-infection was negatively associated with intake of no eggs and no sweets, while HIV-infection was positively associated with lower levels of physical activity. In rural areas, HIV impact on quality of life, as evidenced by reduced levels of physical activity.

A higher percentage of participants living in rural areas tended to be active than those living in urban areas, while significantly more HIV-infected women living in rural communities were more likely to have lower levels of physical activity than their HIV-uninfected counterparts.

9.2.3 Anthropometry

HIV-infected rural and urban participants consistently had lower BMI, WC, MUAC, triceps skinfolds, upper arm fat area and upper arm muscle area compared to HIV-uninfected participants.

Statistically more HIV-uninfected women living in urban areas had a high BMI, WC, MUAC, triceps skinfolds, upper arm fat area and upper arm muscle area compared to HIV-infected urban women. In both samples, HIV-infection was positively associated with low percentage body fat.

9.2.4 Health status

HIV/AIDS-prevalence was higher in urban areas than in rural areas. The younger age and lower BMI of HIV-infected participants make it difficult to compare the health indicators of these participants to those of HIV-uninfected participants.

Significantly more HIV-infected participants in all groups reported experiencing loose stools and diarrhea, involuntary weight loss of more than three kilograms, as well as STDs compared to HIV-uninfected participants, and were therefore at risk to develop malnutrition. In addition, significantly more HIV-infected participants in urban areas reported loss of appetite and skin rash than their HIV-uninfected counterparts. HIV-infected urban participants were significantly more likely to have liver disease, hepatitis and/or jaundice compared to HIV-uninfected urban participants. Significantly more HIV-uninfected participants had hypertension than HIV-infected participants in all areas. When considering ways of dealing with stress, HIV-infection was negatively associated with being a member of a church in both rural and urban samples.

Median levels for cholesterol, HDL and LDL were lower in HIV-infected respondents compared to HIV-uninfected respondents, differences that were statistically significant. Median levels for cholesterol, triglycerides, and HDL and LDL were higher in respondents on ART than in HIV-infected respondents not using ART, but the differences were not statistically significant. Median HbA1c and fasting glucose were slightly lower in HIV-infected respondents than their HIV-uninfected counterparts, differences that were statistically significant (except for HbA1c in rural areas).

HIV-infection was positively associated with having diarrhoea and weight loss (urban) or involuntary weight loss (rural). In both samples a history of HIV (rural and urban) or TB treatment (rural), were positively associated with having TB. HIV-infection was negatively associated with being a member of a church in both rural and urban samples. Results confirm the higher prevalence

of opportunistic infections and the associated symptoms (such as diarrhea and weight loss) in HIV-infected persons.

9.3 RECOMMENDATIONS

9.3.1 Poverty alleviation

Reducing poverty remains a concern and challenge for the South African government. A vicious cycle develops with poverty increasing the likelihood of contracting HIV/AIDS and HIV/AIDS contributing to poverty. Interventions that focus on poverty alleviation can thus make a significant contribution to addressing HIV in South Africa.

It needs to be recognised that nutrition security of individuals and households are influenced by various factors, especially those related to the immediate environment (Labadarios *et al.*, 2011). In South Africa, economic growth has to take place and employment opportunities have to increase in order for all households to have access to food, water, sanitation and healthcare (Labadarios *et al.*, 2011). In the short-term, interventions that improve food availability and access to food by vulnerable groups need to be emphasised (Misselhorn *et al.*, 2007). Such interventions should focus on improving domestic food production, food preservation, and food aid related to budgeting and food purchasing. In this regard it is recommended that communities be taught skills on how to use available resources effectively and be empowered to become involved in food production and income generating projects that will increase income and address food insecurity.

9.3.2 Healthy lifestyle changes

Lifestyle modifications include adequate nutrition, exercise and prevention of weight loss if a patient has a normal body weight. A patient's immune system can be strengthened by educating patients about optimal nutrition and helping them to identify key foods and nutrients as well as education and support on lifestyle changes (Suttajit, 2007). The role of exercise as an additional benefit to the health treatment of HIV-infected patients should be emphasised (Jones, 2001). Malnutrition increases fatigue and physical inactivity in HIV-infected persons (Piwoz and Preble,

2000). Therefore interventions aimed at improving quality of life in HIV-infected patients, should aim to improve nutritional status, which, in turn, will result in improved levels of physical activity. Exercise may also be used to address unwanted changes in weight and body composition in HIV-infected patients on HAART (O'Brien *et al.,* 2004) and has been used successfully to treat psychological conditions such as depression and anxiety that are common in HIV-infected individuals (Dudgeon *et al.,* 2004).

Interventions aimed at improving nutritional status and quality of life in HIV-infected persons should aim at preventing weight loss. On the other hand, there is a need for a sustainable strategy to address the prevalence of overweight and obesity in both the general population and in patients on HAART. The introduction of education and awareness programmes that focus on the treatment of the current emerging trend of chronic diseases of lifestyle and metabolic syndrome in these communities needs to be emphasised (Van Zyl *et al.*, 2012). Therefore, effective, affordable and acceptable nutrition interventions for HIV-infected patients are critical in the care of HIV-infected patients (Piwoz and Preble, 2000).

9.3.3 Social support networks

The results of this study show that social and moral support, such as that offered by churches, makes a significant contribution to addressing the challenges of HIV. Therefore a necessary supportive environment should be created within the Mangaung community in order to maintain or improve quality of life of those infected with the virus (Hattingh *et al.,* 2009). This can be achieved by promoting various forms of social control for HIV-prevention through community support groups and providing social environments for challenging stigmatising ideas and practices (Campbell *et al.*, 2011). HIV-prevention efforts should focus strongly on young girls, and those currently not infected with HIV (Mukherjee *et al.,* 2003). Features of supportive social environments may include: improvement of HIV/AIDS-related knowledge and skills; opportunities for critical dialogue and debate about HIV/AIDS; a sense of individual and communal ownership of the problem and responsibility for contributing to its solution; confidence in the existence of individual, group and community strengths which could be activated to fight the epidemic; a sense

of solidarity amongst group members around addressing HIV/AIDS; and strong links with potential support organisations in the public and private sector (Campbell *et al.*, 2011).

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APPENDIX A: Assuring Health for All (AHA) in the Free State

SOCIO-DEMOGRAPHIC AND HOUSEHOLD QUESTIONNAIRE

(All information in this questionnaire is confidential).

Town:_____ 1

Household number: 2-5

Member number: 6-7

Interviewer: _____ 8-9

Interview Date: D D M M Y Y Y Y 10-17

For each individual living in the household (5-7 days per week), provide the following:

Household Member	Name	Relation to head of household	Sex	Education	Birth date D D M M Y Y Y Y	
0 1	_____					18-31
0 2	_____					32-45
0 3	_____					46-59
0 4	_____					60-73
0 5	_____					1-14
0 6	_____					15-28
0 7	_____					29-42
0 8	_____					43-56
0 9	_____					57-70
1 0	_____					1-14
1 1	_____					15-28
1 2	_____					29-42

For each individual who was living in the house and died within the past 2 years, provide the following:

Name	Relation	Sex	Education	Birth date D D M M Y Y Y Y	
_____					43-54
_____					55-66
_____					67-78
_____					1-12

Household member number of person with whom interview is being conducted: 13-14

How many years have you been living in a rural area (at least 30km away from big city)? 15-16

Encircle the appropriate answer:

First language of household: ☐ 17

1. Sotho
2. Tswana
3. English
4. Afrikaans
5. Other, specify_____

Employment status of respondent: ☐ 18

1. Housewife by choice
2. Unemployed
3. Self Employed
4. Full time wage earner (receive a salary)
5. Other, specify (part-time, piece job etc.)_____
6. Don't Know

Husband/ partner's employment status: ☐ 19

1. Retired by choice
2. Unemployed
3. Self Employed
4. Full time wage earner (receive a salary)
5. Other, specify (part-time, piece job etc.)_____
6. Not Applicable e.g. dead

Type of dwelling: ☐ 20

1. Brick, Concrete
2. Traditional mud
3. Tin
4. Plank, wood
5. Other, specify_____

Total number of rooms in house: _____ ☐☐ 21-22

Number of bedrooms: _____ ☐ 23

Do you have a bathroom in the house? 1=Yes 2=No ☐ 24

Do you have a bathroom outside? 1=Yes 2=No ☐ 25

Do you have a kitchen or cooking area inside the house? 1=Yes 2=No ☐ 26

Does the household have electricity? 1=Yes 2=No ☐ 27

Where do you get drinking water most of the time? ☐ 28

1. Own tap
2. Communal tap
3. River, dam
4. Borehole, well

Other, specify _____

What type of toilet does this household have? ☐ 29

1. Flush
2. Pit
3. Bucket, pot
4. VIP
5. Other, specify _____

What fuel is used for cooking most of the time? ☐ 30

1. Electric
2. Gas
3. Parrafin
4. Wood, Coal
5. Sun
6. Open fire

Do you use a cast iron pot for cooking? ☐ 31

1. Never
2. ≤ Once a week
3. > Once a week
4. Every day

Does the home have a working:

Refrigerator and/or freezer ☐ 32

1.Yes
2.No

Stove (Gas, Coal or electric) or Hot Plate ☐ 33

1. Yes
2. No

Primus or Paraffin Stove ☐ 34

1. Yes
2. No

Microwave ☐ 35

1. Yes
2. No

Radio ☐ 36

1. Yes
2. No

Television ☐ 37

1. Yes
2. No

How many people contribute to the total income? _____ ☐☐ 38-39

Household income per month (including wages, rent, sales of vegs, etc. State grants). ☐ 40

1. None
2. R100-R500
3. R501- R1000
4. R1001-R3000
4. R3001-R5000
5. Over R5000
6. Don't know

Is this more or less the income that you had over the past six months? ☐ 41

1. More
2. Less

The same

Race of the family: ☐ 42

1. Black
2. Coloured
3. White
4. Mixed

Codes to be used for coding of questionnaires:

Level of education:

1. None
2. Primary School
3. Std 6-8
4. Std 9-10
5. Tertiary Education
6. Don't Know

Relation to head of the household:

1. Head of the household
2. Spouse
3. Child
4. Sibling
5. Mother/ Father
6. Mother-in-law/ Father-in-law
7. Grandchild
8. Daughter-in-law/ Son-in-law
9. No relation
10. Other

Gender:

1. Male
2. Female

APPENDIX B: Assuring Health for All (AHA) in the Free State

HOUSEHOLD FOOD SECURITY AND FOOD PROCUREMENT QUESTIONNAIRE

(All information in this questionnaire is confidential)

Town:_____ [ ] 1

Household number: [ ][ ][ ][ ] 2-5

Member number (as on socio-demographic form): [ ][ ] 6-7

Interviewer: _____ [ ][ ] 8-9

Interview Date: **D D M M Y Y Y Y** [ ][ ][ ][ ][ ][ ][ ][ ] 10-17

How much money is spent on food for the household weekly? [ ][ ] 18-19

1. R0-R50
2. R51-R100
3. R101-R150
4. R151-R200
5. R201-R250
6. R251-R300
7. R301-R350
8. R351-R400
9. Over R400
10. Don't know

What is your main source of income? [ ] 20

1. wages and salaries from formal employment
2. self employment (including home enterprises)
3. casual employment (agricultural or non agricultural)
4. crop production and livestock sales
5. sale of assets
6. land/ flats /equipment rental
7. old age pension or state grant
8. domestic work
9. other: specify _____

FOOD PRODUCTION, PRESERVATION AND AVAILABILITY

Do you grow vegetables? 1=yes 2=no [ ] 21

If yes, which vegetables do you produce?

1. Cabbage [ ] 22
2. Carrots [ ] 23
3. Green, leafy vegetables [ ] 24
4. Pumpkin [ ] 25
5. Beans [ ] 26
6. Beetroot [ ] 27
7. Other: specify _____ [ ] 28

Do you grow crops? 1=yes 2=no [ ] 29

If yes, which crops do you produce?

1. Maize [ ] 30
2. Wheat [ ] 31
3. Sorghum [ ] 32
4. Potatoes [ ] 33
5. Other: specify _____ [ ] 34

What % of the annual agricultural yield is sold? _____ [ ][ ][ ] 35-37

Do you have your own fruit trees? 1=yes 2=no [ ] 38

If yes, what fruit do you grow?

1. Peaches [ ] 39
2. Appricots [ ] 40
3. Grapes [ ] 41
4. Apples [ ] 42
5. Oranges [ ] 43
6. Other: specify _____ [ ] 44

Do you own livestock? 1=yes 2=no [ ] 45

If yes, which livestock do you own and how many?

1. Beef cattle, specify how many_____ [ ][ ][ ][ ] 46-49
2. Dairy cattle, specify how many_____ [ ][ ][ ][ ] 50-53
3. Sheep, specify how many_____ [ ][ ][ ][ ] 54-57
4. Goats, specify how many_____ [ ][ ][ ][ ] 58-61
5. Pigs, specify how many_____ [ ][ ][ ][ ] 62-65
6. Chickens, specify how many_____ [ ][ ][ ][ ] 66-69
7. Other: specify _____ [ ][ ][ ][ ] 70-73

Do you usually produce enough food to last until the next season? 1=yes 2=no [ ] 74

If yes, which food usually lasts until the next harvest? 1=yes 2=no

1. vegetables [ ] 75
2. crops [ ] 76
3. fruits [ ] 77
4. other: specify _____ [ ] 78

If not, what are the reasons [ ] 79

1. not enough land
2. not enough money to buy seeds and other equipment
3. other: specify _____

Do you keep food for future use? 1=yes 2=no [ ] 80

If yes, which method do you mostly use? [ ] 1

1. sun drying
2. canning
3. freezing
4. other: specify_____

What is your main reason for producing food? [ ] 2

1. consumption by family members
2. to sell
3. to exchange for clothes and household equipment
4. other: specify_____

Are fruits easily available from the local farmers and shops? 1=yes 2=no [ ] 3

Are vegetables easily available from the local farmers and shops? 1= yes 2=no [ ] 4

What form of transport do you mainly use to buy food? ☐ 5

1. Foot
2. Bicycle
3. Public transport e.g. taxi
4. Car
5. Other _____

Who in the family is served first when meals are served? ☐ 6

1. Father/ men in the family
2. Mother/ women in the family
3. Children
4. All eat at the same time
5. Lives and eats alone

HUNGER SCALE

Does your household ever run out of money to buy food? ☐ 7

1. yes
2. no

Do you ever rely on a limited number of foods to feed your children? ☐ 8

1. yes
2. no

Do you ever cut the size of meals or skip any because there is not enough food in the house? ☐ 9

1. yes
2. no

Do you ever eat less than you should because there is not enough money for food? ☐ 10

1. yes
2. no

Do you your children ever eat less than you feel they should because there is not enough money for food? ☐ 11

1. yes
2. no

Do your children ever say they are hungry because there is not enough food in the house? ☐ 12

1. yes
2. no

Do you ever cut the size of your children's meals or do they ever skip meals because there is not enough money to buy food? ☐ 13

1. yes
2. no

Do any of your children ever go to bed hungry because there is not enough ☐ 14

money to buy food?

1. yes
2. no

Has the family ever experienced periods of food shortage? ☐ 15

1. yes
2. no

If yes, how did the family cope during this period? ☐☐ 16-17

1. Found other/additional sources of income
2. asked family/relatives/ neighbours for help (money/food)
3. family members went to live elsewhere
4. sold assets
5. worked for payment in kind
6. depended on charity/welfare
7. borrowed money/food
8. increased production of food
9. could not do anything
10. other: specify _____

APPENDIX C

Assuring Health for All (AHA) in the Free State

Dietary intake questionnaire

24-hour recall

Town: _____ 1

Household number: 2-5

Member number (as on socio-demo form): 6-7

Interviewer:_____ 8-9

Food and fluid intake (expressed in exchanges):

Food/Drinks and amounts	**Milk and milk products**	**Meat and meat alternatives**	**Legumes**	**Fruit ß-carotene**	**Vegetables ß-carotene**	**Fruit Vit C**	**Vegetables Vit C**	**Fruit other**	**Vegetables other**	**Bread and cereals**	**Fats and oils**	**Sweets/Sugar**	**Alcohol**
Breakfast and mid-morning													
Lunch and mid afternoon													
Supper and late night													
Total:													

Assuring Health for All (AHA) in the Free State
DIETARY DIVERSITY DATA FORM

Assuring Health for All (AHA)		Town: _____					1		
in the Free State		Household number:					2-4		
Dietary Diversity		Member number (as on socio-demo form)					5-6		
Questionnaire									
			YES=1		**Number of**				
Question number		**Food group**	**NO=2**		**exchanges**				
1		CEREALS		7			8-9		
2		WHITE ROOTS AND TUBERTS		10			11-12		
3		VITAMIN A RICH VEGETABLES AND TUBERS		13			14-15		
4		DARK GREEN LEAFY VEGETABLES		16			17-18		
5		OTHER VEGETABLES		19			20-21		
6		VITAMIN A RICH FRUITS		22			23-24		
7		OTHER FRUIT		25			26-27		
8		ORGAN MEAT		28			29-30		
9		FLESH MEAT		31			32-33		
10		EGGS		34			35-36		
11		FISH AND SEAFOOD		37			38-39		
12		LEGUMES, NUTS AND SEEDS		40			41-42		
13		MILK AND MILK PRODUCTS		43			44-45		
14		OILS AND FATS		46			47-48		
15		SWEETS		49			50-51		
16		SPICES, CONDIMENTS, BEVERAGES		52			53-54		
		Low DDS (≤ 3 food groups)	1				55		
		Medium DDS (4 and 5 food groups)	2						
		High DDS (≥ 6 food groups)	3						

APPENDIX D
Assuring Health for All (AHA) in the Free State
24 Hour Physical Activity Recall

Town: _____ | 1

Household number: | 2-5

Member number: | 6-7

Interviewer:_____ | 8-9

Time of day	Activity (Number): Use attached coding list					
12:00-12:30 AM			,			
12:30-1:00			,			
1:00-1:30			,			
1:30-2:00			,			
2:00-2:30			,			
2:30-3:00			,			
3:00-3:30			,			
3:30-4:00			,			
4:00-4:30			,			
4:30-5:00			,			
5:00-5:30			,			
5:30-6:00			,			
6:00-6:30			,			
6:30-7:00			,			
7:00-7:30			,			
7:30-8:00			,			
8:00-8:30			,			
8:30-9:00			,			
9:00-9:30			,			
9:30-10:00			,			
10:00-10:30			,			
10:30-11:00			,			
11:00-11:30			,			
11:30-12:00 PM			,			
12:00-12:30			,			
12:30-1:00			,			
1:00-1:30			,			
1:30-2:00			,			
2:00-2:30			,			
2:30-3:00			,			
3:00-3:30			,			
3:30-4:00			,			
4:00-4:30			,			
4:30-5:00			,			
5:00-5:30			,			
5:30-6:00			,			
6:00-6:30			,			
6:30-7:00			,			
7:00-7:30			,			
7:30-8:00			,			

8:00-8:30			,			
8:30-9:00			,			
9:00-9:30			,			
9:30-10:00			,			
10:00-10:30			,			
10:30-11:00			,			
11:00-11:30			,			
11:30-12:00 PM			,			

Total PAL Value (A) | , | 10-14

For activities **not reported in the recall**, complete the frequency of the following:

Activity	Duration	Times/day	Times/week	Average/day	PAL/hr
Carrying heavy Items					,
Chopping wood					,
Driving a car					,
Food preparation					,
Gardening (watering)					,
Gardening (no lifting)					,
Gardening (mowing)					,
Housework					,
Playing soccer					,
Riding a bicycle					,
Riding in a car/bus/taxi					,
Running					,
Shopping					,
Skipping rope					,
Total PAL value B					,

Total PAL Value (B) | , | 15-19

Final PAL Value (A+B) +1.1 | , | 20-24

PAL Category (according to table below): | 25

PAL category	PAL values
1. Sedentary	1-1.39
2. Low active	1.4-1.59
3. Active	1.6-1.89
4. Very active	1.9-2.5

Intensity and Impact of Various activities on Physical Activity Levels in Adults

(derived from Carroll & Johnson, 2004, Table 2-4, p. 33)

	PAL/10 min	PAL/30 min
Bath/shower/washing yourself	0.005	0.015
Chopping wood	0.037	0.111
Driving a car	0.005	0.015

Eating	0.005	0.015
Food preparation	0.014	0.042
Gardening - watering plants	0.014	0.042
Gardening – no lifting	0.032	0.096
Gardening – mowing lawn	0.033	0.099
Housework (moderate effort) includes washing laundry	0.024	0.072
Playing soccer	0.088	0.264
Riding a bicycle	0.024	0.072
Riding in a car/bus/taxi	0	0
Running/jogging	0.088	0.264
Sitting with light activity	0.005	0.015
Sitting without activity (e.g. watch TV)	0	0
Sleeping	0	0
Walking (3.2 km/h)	0.014	0.042
Walking (4.8 km/h)	0.022	0.066
Weight lifting	0.061	0.183

PAL calculation

(BEE*+TEF**)+Total of PAL/day=Energy expenditure/day
1.0+10%=1.1+ (PAL/day).

*BEE is always 1 and stands for Basal Energy Expenditure
**TEF=Thermic effect of food and is always 10%

Eg. Walk 20min (0.014*2)=0.028Chopped wood 10 min (0.037*1)=0.037
Played soccer 30min (0.088*3)=0264

Add all the Above totals=0.028 + 0.037 + 0.264 = **0.329= Total Daily PAL**

1+0.1+0.329 **= 1.429**

The answer is then an indication of the amount of physical activity per day.

Due to the fact that not all activities will be mentioned in the 24 hour recall, the physical activity frequency form will be used for cross-referencing and incorporating the information by using the following calculations:

Activity PAL x the frequency x duration of activity = Energy expended per week.

This procedure will be followed for all activities and added to get a total PAL per week. The Total PAL /Week will then be divided by 7 to get the average PAL / day, which will then be used in the following formula:

(BEE+TEF)+Total of PAL/day=Energy expenditure/day
1.0+10%=1.1+ (PAL/day).

EG. chop wood 3 times/ week for 10min each
((0.037*1)*3= 0.111. (The average amount of energy spent on chopping wood per week).
Walk for 30min each day
(0.022*3)*7=0.462

0.111+0.462=0.573=Weekly PAL

1+0.1+0. 573=1.673
1.673/7 =**0.239** = daily energy expenditure

You will now have 2 totals, i.e. (1) the amount of energy expended on average per day, using the Physical Activity Frequency and (2) the amount calculated from the 24 hour recall. These 2 totals will then be added and divided by 2 to get the average energy expended per day. This is done to include activities which are not done on a daily basis:

(1.429+0.239) /2 = 0.834

You then compare your answer in the above formula to the amounts as used by Carroll & Johnson (2004b) to determine daily activity level, which is classified into sedentary, low active, active or very active categories (Carroll & Johnson, 2004b), with the Table below:

PAL category	**PAL values**	**Walking equivalence (miles/day at 3-4 mph)**
Sedentary	1-1.39	
Low active	1.4-1.59	1.5, 2.2, 2.9 for PAL = 1.5
Active	1.6-1.89	3, 4.4, 5.8 for PAL = 1.6 5.3, 7.3, 9.9 for PAL = 1.75
Very active	1.9-2.5	7.5, 10.3, 14 for PAL = 1.9 12.3, 16.7, 22.5 for PAL = 2.2 17, 23, 31 for PAL = 2.5

APPENDIX E: Assuring Health for All (AHA) in the Free State
Anthropometry

Town:_____ | 1

Household number: | 2-4

Member number (as on socio-demographic form): | 5-6

Interview Date: (D D M M Y Y Y Y) | 7-14

Measurer (interviewer):_____ | 15-16

Weight (kg):_____ | 17-21

Height (cm): _____ | 22-26

If height cannot be measured:

Knee height (cm):_____ | 27-31

Demispan (cm):_____ | 32-36

Circumferences (cm):

Upper-arm (adults and children):_____ | 37-40

Waist (adults): _____ | 41-45

Hip (adults): _____ | 46-50

Wrist (adults):_____ | 51-54

Head circumference (children):_____ | 55-58

Bio-impedance fat percentage (adults):_____ | 59-62

Skinfold thicknesses (mm):

Triceps (adults and children):	_____	_____	_____	63-64
Biceps (adults):	_____	_____	_____	65-66
Supra-ileac (adults):	_____	_____	_____	67-68
Subscapular (adults):	_____	_____	_____	69-70
Thigh (adults):	_____	_____	_____	71-72
Calf (adults):	_____	_____	_____	73-74

APPENDIX F: Assuring Health for All (AHA) in the Free State

HEALTH QUESTIONNAIRE

(All information in this questionnaire is confidential).

Town:_____ | 1

Household number: | 2-5

Member number (as on socio-demographic form): | 6-7

Interviewer: _____ | 8-9

Interview Date: D D M M Y Y Y Y | 10-17

Marital status: | **18**

1. Child
2. Never married
3. Currently married/ Traditional marriage
4. Living with partner
5. Widowed
6. Separated
7. Divorced
8. Other, specify_____

Which best describes your history of smoking? | 19

1. Never smoked
2. Currently smoke
3. Formerly smoked

If yes, how many cigarettes per day?_____ | 20-21

If yes, at what age did you start? _____ | 22-23

Which best describes your history of snuffing? | 24

1. Never used snuff
2. Currently use snuff
3. Formerly used snuff

If yes, how many times per day do you snuff_____ | 25-26

If yes, at what age did you start? _____ | 27-28

Which best describes your history of alcohol use? | 29

1. Never used alcohol products
2. Currently use alcohol products
3. Formerly used alcohol products

If currently, what form of alcohol do you use regularly (at least once a week)? 1=yes 2=no

1. Spirits (rum, whisky, gin, vodka etc.) | 30

2. Wine [ ] 31

3. Beer [ ] 32

4. Homemade beer [ ] 33

At least once a month, do you consume >5 alcoholic drinks per day? 1=yes 2=no [ ] 34

At what age did you start using alcohol? _____ [ ][ ] 35-36

On weekends, how many alcohol-containing drinks do you consume?_____ [ ][ ] 37-38

Do you feel tired on Monday after heavy alcohol consumption (more than 5 drinks per day) during the weekend? 1=yes 2=no [ ] 39

Usual sleeping habits:

What time do you usually go to bed at night?_____ [ ][ ]:[ ][ ] 40-44

What time do you usually wake up in the morning?_____ [ ][ ]:[ ][ ] 45-49

Do you usually take naps during the day? 1=yes 2=no [ ] 50

Current disability: 1=yes 2=no

1. Do you have any trouble walking about? [ ] 51
2. Do you have trouble seeing someone across the room (with glasses worn)? [ ] 52
3. Do you have trouble reading or seeing individual grains of rice/corn on your plate (with glasses)? [ ] 53
4. Do you have trouble speaking and being understood? [ ] 54
5. Do you have trouble hearing? [ ] 55

Have you experienced any of the following in the last six months? 1=yes 2=no

1. Chest pain or tightness with usual activity [ ] 56
2. Breathlessness with usual activity [ ] 57
3. Cough for at least 2 weeks [ ] 58
4. Wheezing or whistling in the chest [ ] 59
5. Loose stools/ diarrhoea for at least 3 days [ ] 60
6. Vomiting [ ] 61
7. Loss of appetite [ ] 62
8. Swelling of feet [ ] 63
9. Blood in urine [ ] 64
10. Involuntary weight loss of > 3 kg [ ] 65
11. Skin rash [ ] 66
12. Joint pain [ ] 67
13. Sexually transmitted diseases [ ] 68

Have YOU ever been diagnosed with the following? 1=yes 2=no

1. Diabetes		69
2. High blood pressure		70
3. Stroke		71
4. Heart disease/ Angina/ Heart attack		72
5. Heart failure		73
6. Cancer		74
7. Liver disease/ Hepatitis/ Jaundice		75
8. Lung disease e.g. emphysema or asthma		76
9. Tuberculosis		77
10. HIV/AIDS		78
11. Epilepsy		79
12. Allergy		80

Has a family member (parents, siblings, children) ever been diagnosed with the following? 1=yes 2=no

1. Diabetes		1
2. High blood pressure		2
3. Stroke		3
4. Heart disease/ Angina/ Heart attack		4
5. Heart failure		5
6. Cancer		6
7. Liver disease/ Hepatitis/ Jaundice		7
8. Lung disease e.g. emphysema or asthma		8
9. Tuberculosis		9
10. HIV/AIDS		10
11. Epilepsy		11
12. Allergy		12

Medication

Are you taking medication regularly (ie. at least once per week) 1=yes 2=no | | 13

If yes, list the medication that you are currently using (including traditional medicine).

_____

_____		14-15
_____		16-17
_____		18-19
_____		20-21
_____		22-23
_____		24-25
_____		26-27
_____		28-29

During the past 12 months, have you been hospitalised? 1=yes 2=no		30
If yes, how many times? _____		
If yes, give details (e.g. for specific operation or treatment)_____		23-32
If yes, for how many days?_____		33-34

For women only: 1=yes 2=no

1. Are you currently pregnant?		35
2. Do you still have periods?		36
3. Have you ever used an injectable contraceptive?		37
4. How many live children have you given birth to?_____		38
5. Did you breastfeed any of your children?		39
6. If yes, at what age (months) did you add anything other than breast milk to the diet?_____		40-41

Social situation and stress:

Are you a member of a church?_____ 1=Yes 2=No		42
Do you attend services at least 2x/month? 1=Yes 2=No		43
Stress is defined as feeling irritable or filled with anxiety, or as having sleeping difficulties as a result of conditions at work or at home. How often have you felt stress in the last 2 months?		44

1. Never
2. A few periods of stress
3. Several periods of stress
4. Permanent stress

Have you experienced any of the following during the past 12 months? 1=yes 2=no

1. Loss of job		45
2. Retirement		46
3. Loss of crop/ business failure		47
4. Household break in		48

5. Marital separation/ divorce		49
6. Other major intra-family conflict? If yes, specify _____		50
7. Major personal injury or illness		51
8. Violence		52
9. Death of a spouse		53
10 Death or major illness of another family member		54
11. Wedding of family member		55
12. New job		56
13. Birth in the family		57
14. Separation from family		58
15. Unavailablity of food/ Food insecurity		59
16 Other major stress? If yes, specify _____		60
During the past 12 months, was there ever a time when you felt sad, blue or depressed for two weeks or more in a row? 1=yes 2=no		61
Are you willing to answer questions related to HIV/AIDS? 1=yes 2=no		62
If yes, do you know people who have HIV/AIDS? 1=yes 2=no		63
If yes, which of these people: 1=yes 2=no		
1. Your children		64
2. Your grandchildren		65
3. Your spouse		66
4. Your family members		67
5. Your friends		68
6. People in the community		69
Do you care for orphans in your household? 1=yes 2=no		70

APPENDIX G: Assuring Health for All (AHA) in the Free State
Medical examination
(All information in this questionnaire is confidential).

Town:_____ 1

Household number: 2-5

Member number (as on socio-demographic form): 6-7

Interviewer: _____ 8-9

Interview Date: D D M M Y Y Y Y 10-17

Blood pressure: (Right arm supine; systolic / diastolic mmHg) 18-23
Heart rate (bpm) 24-26

1. Are any of the following visible/tangible?

Jaundice	Yes (1)	No (2)	27
Anaemia (Pale)	Yes (1)	No (2)	28
Clubbing	Yes (1)	No (2)	29
Cyanosis	Yes (1)	No (2)	30
Lymphadenopathy	Yes (1)	No (2)	31
Oedema	Yes (1)	No (2)	32

2. Are there any cardiovascular abnormalities? Yes (1) No (2) 33

If yes, specify 34-35
1._____

_____
2. 36-37
_____

_____

3. Are there any respiratory abnormalities? Yes (1) No (2) 38

If yes, specify 39-40
1._____

_____
2. 41-42
_____

_____

4. Is there any abdominal pathology? | Yes (1) | No (2) | 43

If yes, specify

1._____ 44-45

_____

2. 46-47

_____

_____

5. Are there any nervous system abnormalities? | Yes (1) | No (2) | 48

If yes, specify 49-50

1._____

_____

2. 51-52

_____

_____

6. Is there any skin pathology? | Yes (1) | No (2) | 53

If yes, specify 54-55

1._____

_____

2. 56-57

_____

_____

Comments:

_____
_____
_____
_____
_____

_____ _____

Ondersoeker / Examiner **Datum / Date**

PRE-TEST CONSENT TO HIV TESTING

To be completed by the patient/ client:

Do you know what AIDS is?	Yes	No
Has it been explained to you how the test is done?	Yes	No
Have the advantages of the test been explained?	Yes	No
Have the disadvantages of the test been explained?	Yes	No
Has it been explained to you how a positive result will affect your treatment?	Yes	No
Has it been explained to you what will happen if you are not tested?	Yes	No
Do you want to know the result of your HIV test?	Yes	No

To be completed by the counselor:

Have you explained to the patient/ client:

What AIDS is?	Yes	No
How the test will be done?	Yes	No
What the advantages of testing are?	Yes	No
What the disadvantages of testing are?	Yes	No
Why the information is needed?	Yes	No
How a positive result will affect treatment?	Yes	No
What will happen if the test is not done?	Yes	No
Have you yourself explained the above?	Yes	No
Has a translator been used to explain the above?	Yes	No

_____ _____

Signature of Participant Date

_____ _____

Signature of Counselor Date

For children:

_____ _____

Name/ Signature of Child Date

_____ _____

Signature of Parent Date

APPENDIX H: Assuring Health for All (AHA) in the Free State

CONTRACT BETWEEN UNIVERSITY OF THE FREE STATE AND FIELD WORKER

You have been asked to assist in obtaining informed consent from participants to participate in a research study in your town.

You may contact Dr Corinna Walsh at 083 297 6030 at any time if you have questions about the research.

If you agree to assist in obtaining informed consent from members of the community where you live, the following will be expected from you:

- You should visit approximately 15 households in your area (as divided during the training session) where you need to explain the purpose of the research according to the information document that accompanies the informed consent form.
- After the community member has agreed to participate, they need to sign the infomed consent form (one form for each of the one or two adults that agree to participate as well as a form for each pre-school child in the household, signed by the parent/caregiver of the child).
- You can leave the information document with the community members, but need to collect all the signed consent forms for the researchers (keep them with you until the day of the research).
- You need to give the family a form on which the day that they will be attending the research is indicated and explain that they should not eat or drink anything on the morning that they will be attending the research unit.
- You need to accompany the family for which you have obtained consent to the research unit early on the day that they need to attend together with their signed consent forms.

You will be paid an amount of R200 when all the families for which you are responsible (about 15 families) have been brought to the research unit with their signed forms.

_____ _____

Signature of Fieldworker Date

_____ _____

Signature of Project leader Date

Assuring Health for All (AHA) in the Free State

KONTRAK TUSSEN DIE UNIVERSITEIT VAN DIE VRYSTAAT EN VELDWERKER

U is gevra om ons behulpsaam te wees met die verkryging van ingeligte toestemming van deelnemers wat instem om deel te neem aan ‘n navorsingstudie in u dorp.

U kan ten enige tyd vir Dr Corinna Walsh by 083 297 6030 kontak indien u vrae het in verband met die navorsing.

Indien u toestem om behulpsaam te wees met die verkryging van ingeligte toestemming vanaf lede van u gemeenskap, sal die volgende van u verwag word:

- U moet ongeveer 15 huishoudings in u area (soos verdeel tydens die opleidingsessie) besoek, waar u die doel van die navorsing moet verduidelik volgens die inligtingsdokument wat die ingeligte toestemmingsvorm vergesel.
- Nadat die gemeenskapslid ingestem het om deel te neem aan die navorsing, moet hulle die ingeligte toestemmingsvorm teken (een vorm vir elk van die een of twee volwassenes wat ingestem het sowel as ‘n vorm vir elke voorskoolse kind in die huishouding, geteken deur die ouer of versorger van die kind).
- U kan die inligtingsdokument by die gemeenskapslid laat, maar moet die getekende ingeligte toestemmingsvorms saam met u neem vir die navorsers (hou die vorms by u tot die dag van die navorsing).
- U moet vir die gesin ‘n vorm gee waarop die dag van die navorsing aangedui is en verduidelik dat hulle die oggend waarop hulle aan die navorsing gaan deelneem niks moet eet of drink nie.
- U moet die huishoudings vir wie u ingeligte toestemming verkry het vroeg op die dag wat hulle moet deelneem aan die projek vergesel na die navorsingseenheid (saal) tesame met hul getekende ingeligte toestemmingsvorms.

U sal ‘n bedrag van R200 ontvang wanneer u alle gesinne waarvoor u verantwoordelik is (ongeveer 15 gesinne) na die navorsingseenheid gebring het met hulle getekende ingeligte toestemmingsvorms.

_____ _____

Handtekening van Veldwerker Datum

_____ _____

Handtekening van Projekleier Datum

APPENDIX I: Assuring Health for All (AHA) in the Free State

CONSENT TO PARTICIPATE IN RESEARCH

You have been asked to participate in a research study.

You have been informed about the study by …… .

You may contact Dr Corinna Walsh at 083 297 6030 at any time if you have questions about the research or if you are injured as a result of the research.

You may contact the Secretariat of the Ethics Committee of the Faculty of Health Sciences, UFS at telephone number (051) 4052812 if you have questions about your rights as a research subject.

Your participation in this research is voluntary, and you will not be penalized or lose benefits if you refuse to participate or decide to terminate participation.

If you agree to participate, you will be given a signed copy of this document as well as the participant information sheet, which is a written summary of the research. You are also giving permission that some of the same blood can be retained in storage for possible future research related to the present research question.

The research study, including the above information has been verbally described to me. I understand what my involvement in the study means and I voluntarily agree to participate.

_____ _____

Signature of Participant Date

For children:

_____ _____

Name/ Signature of Child Date

_____ _____

Signature of Parent Date

Assuring Health for All (AHA) in the Free State
INFORMATION DOCUMENT

Study title: Assuring Health for All (AHA) in the Free State

Thank you for being willing to help us in this very important project. We are sure that the project will contribute to improving the health of all the people of the Free State.
We, the University of the Free State, Faculty of Health Sciences, are doing research on determining the factors involved in causing disease and disability in the Southern Free State. Research is just the process to learn the answer to a question. In this study we want to learn what factors need to be addressed in health programmes in the Free State. The study involves research and is not part of routine medical care.

Invitation to participate: We are asking/inviting you to participate in this research study, or/and asking for your permission to include your child in this research study.

What is involved in the study: The aim of the project is to get enough information regarding the development of chronic diseases like diabetes, stroke, high blood pressure and heart disease as well as HIV/AIDS to plan appropriate health and nutrition intervention strategies for the people of the Free State. Trompsburg, Philippolis and Springfontein have been chosen as the rural areas and Mangaung as the urban area.

For this study we need households whom we can follow for 12 years. The baseline survey will be done from March 2007 to November 2007. You will be asked to visit the nearest research site for one day to take the necessary measurements and to complete the questionnaires. After the baseline survey has been completed, we will implement a nutrition intervention in your community to address the problems identified in the baseline survey. This intervention will form part of the service learning interventions of the University. In addition to the services that we will render in the community, we will visit your community again after three to six years to repeat the measurements.

All the questionnaires will be filled out at the nearest research site or at your household by students from the University of the Free State or by trained research field workers who are from your communities. Respondents from the chosen households will be asked to complete the following questionnaires in an interview with the student or field worker:

- Socio-demographic and household questionnaire,
- Household food security and food procurement questionnaire,
- Health questionnaire,
- Knowledge, practices and attitudes (KPA) about nutrition questionnaire,
- Diet and physical activity questionnaire.

We will also take some measurements such as weight, height, skinfold thicknesses, blood pressure, blood samples and a urine sample. With your permission we will draw 60ml of blood in adults and 15ml in children and this will only be done once. In adults blood and urine samples will be used to determine the following: Full blood count; HbA1c; Glucose; Insulin; Lipogram; Homocysteine; Red cell Folic acid; Serum Vitamin B12; Fibrinogen; Gamma glutermyl transferases (GGT); Carbohydrate-deficient transferrin (CDT); Ferritin; Uric acid; Creatinin; C-reactive protein; Albumin; Pre-albumin; Transferrin; Retinol-binding protein; TSH; Iodine (urine); Leptin; Tumour Necrosis Factor alpha; Interleuken 6; Melatonin; Brain natriuretic peptide; ACTH; Cortisol; Orexin; Urotensin-11; Endothelin 1; Plasminogen Activation Inhibitor (PAI-1); Adiponectin; Micro-albuminuria (urine); Glucose tolerance (sub-sample); FFA (sub-sample).

A short medical examination will be performed on some household members to identify any serious health problems.

We would like to retain some of the same blood in storage for possible future research related to the present research question. Blood samples will be stored anonymously for a period of five years at the Department of Chemical Pathology at the University of the Free State. If you are unhappy to have your blood stored for

future research, it will be disposed of at the end of the study, once the sample storage and record-keeping requirements of good research practice have been met.

It is very important that we gather quality data and knowledge. Because HIV/AIDS is a devastating illness and affects almost all aspects of health, it is necessary to know if HIV is absent before we analyse the data. It will be to your benefit as well as the benefit of the research to determine your HIV status. Therefore we will also ask permission to draw blood to determine your HIV status and ask questions about your HIV status which you are allowed not to answer. You will be asked to sign a separate consent form for the HIV test. You will receive pre- and post-testing counselling by a medical practitioner and all results will be kept strictly confidential in accordance with the guidelines of the Health Professions Council of South Africa (HPCSA). You will only be informed of your HIV result if you choose to be. All respondents who choose to be informed of the results will be informed by a medical doctor and referred for relevant management. None of the researchers (other than one doctor) will know the HIV status of any participants.

Blood tests will involve an analysis of the genetic composition of red blood cells and are aimed at increasing the understanding of the causes and behaviour of chronic diseases of lifestyle such as obesity, diabetes and heart disease. Genes are what you inherit from your parents. They are found in every part of your body and therefore they will be present in the blood that we draw. The findings may benefit/eventually benefit others in terms of prevention or treatment of diseases. You are free to refuse consent and you do not have to give reasons for doing so. The following arrangements have been made to ensure privacy and confidentiality of your genetic information: All blood samples will be stored anonymously at the Department of Chemical Pathology at the University of the Free State. Your genetic material and information will be used in an identifiable form. The research may reveal information of potential importance to the future health of an identifiable or potentially identifiable participant or the participant's offspring.

Researchers will endeavour to provide information about the outcome of the research. If research generates information about you which may be of relevance to the health of other family members, your consent will be sought before offering to disclose such information to the family members concerned. Your material and information will not be released for other uses without consent, unless required by law.

Risks of being involved in the study: Medical doctors or registered nurses will be responsible for safely drawing blood samples. In the unlikely event that an adverse event results from the procedure, you will be compensated for any expenses.
Benefits of being in the study: By participating in the study you will help us to develop health and nutrition strategies that will benefit the people of the Free State. You will be given pertinent information on the study while involved in the project and after the results are available.

Participation is voluntary, and refusal to participate will involve no penalty or loss of benefits to which you are entitled; you may discontinue participation at any time without penalty or loss of benefits to which you are otherwise entitled.
Confidentiality: Efforts will be made to keep personal information confidential. Absolute confidentiality cannot be guaranteed. Personal information may be disclosed if required by law. Organizations that may inspect and/or copy your research records for quality assurance and data analysis include groups such as the Ethics Committee for Medical Research and the Medicines Control Council. If results are published, this may lead to individual/cohort identification.

Kind regards

Dr CORINNA WALSH
Contact details: 083 297 6030 / 051 4013818(W)

Assuring Health for All (AHA) in the Free State

TOESTEMMING TOT DEELNAME AAN NAVORSING

U is versoek om aan ‘n navorsingstudie deel te neem.
U is oor die studie ingelig deur …….. .

U kan Dr Corinna Walsh enige tyd kontak by 083 297 6030 indien u vrae oor die navorsing het of as gevolg van die navorsing beseer is.

U kan die Sekretariaat van die Etiekkomitee van die Fakulteit Gesondheidsweteskappe, UV by telefoonnommer (051) 4052812 kontak indien u enige vrae het oor u regte as ‘n proefpersoon.

U deelname aan hierdie navorsing is vrywillig, en u sal nie gepenaliseer word of voordele verbeur as u weier om deel te neem of besluit om deelname te staak nie.

As u instem om deel te neem, sal ‘n ondertekende kopie van hierdie dokument sowel as die deelnemerinligtingsblad, wat ‘n geskrewe opsomming van die navorsing is, aan u gegee word .

Die navorsingstudie, insluitend die bogenoemde inligting is verbaal aan my beskryf. Ek begryp wat my betrokkenheid by die studie beteken en ek stem vrywillig in om deel te neem.

_____ _____
Handtekening van deelnemer Datum

Vir kinders:

_____ _____
Naam/ Handtekening van kind Datum

_____ _____
Handtekening van ouer Datum

INLIGTINGSDOKUMENT

Studietitel: Assuring Health for All (AHA) in the Free State

Dankie dat u bereid is om ons te help met hierdie baie belangrike projek. Ons is seker dat die projek sal bydra om die gesondheid van alle persone in die Vrystaat te verbeter. Ons, die Universiteit van die Vrystaat, Fakulteit Gesondheidswetenskappe, doen navorsing oor die faktore wat betrokke is by die oorsake van siekte in die Vrystaat. Navorsing is slegs die proses waardeur die antwoord op 'n vraagstuk verkry word. In hierdie studie wil ons leer watter faktore aangespreek moet word in gesondheidsprogramme in die Vrystaat. Die studie behels navorsing en is nie deel van roetine mediese behandeling nie.

Uitnodiging om deel te neem: Ons versoek/nooi u uit om aan 'n navorsingstudie deel te neem of/en vra u toestemming om u kind by die navorsingstudie in te sluit.

Wat behels die studie – Die doelwit van hierdie projek is om genoeg inligting in te samel oor die ontwikkeling van chroniese siektes soos diabetes, beroerte, hoë bloeddruk en hartsiektes sowel as MIV/VIGS om toepaslike gesondheids- en voedingintervensie strategieë te kan beplan vir die mense van die Vrystaat. Trompsburg, Philippolis en Springfontein is as die plattelandse areas gekies en Mangaung as die stedelike area.

Vir die studie benodig ons huishoudings wat ons vir 12 jaar kan opvolg. Die basislyn opname sal in plattelandse areas gedoen word tussen Maart en November 2007. U sal gevra word om die navorsingspunt (saal) naaste aan u vir een dag te besoek waar die nodige metings gedoen sal word en vraelyste voltooi sal word. Nadat die basislynopname voltooi is, sal ons 'n voedingintervensieprogram in u area implementeer om die probleme wat in die basislynopname identifiseer is aan te spreek. Hierdie intervensie vorm deel van die diensleer intervensies van die universiteit. Tesame met die intervensie sal ons ook die gemeenskap elke drie jaar tot ses jaar besoek om die metings te herhaal.

Al die vraelyste sal by u naaste navorsingspunt (saal) of by u huishouding voltooi word deur studente van die Universiteit van die Vrystaat of deur opgeleide navorsingsveldwerkers van u gemeenskap. Respondente van die gekose huishoudings sal gevra word om die volgende vraelyste te voltooi in 'n onderhoud met die student of veldwerker:

- Sosio-demografiese en huishoudelike vraelys,
- Huisehoudelike voedselsekuriteit en voedselverkrygings vraelys,
- Gesondheids vraelys,
- Kennis, praktyke en houding teenoor voeding vraelys,
- Dieet en fisiese aktiwiteit vraelys.

Ons sal ook sekere metings soos gewig, lengte, velvoudiktes, bloeddruk, bloed monsters en uriene monsters neem. Met u toestemming sal ons in volwassenes 60ml bloed trek en in kinders 15ml en dit sal slegs een keer geskied. In volwassenes sal bloed en uriene monsters gebruik word om die volgende te bepaal: Volbloedtelling; HbA1c; Glukose; Insulien; Lipogram; Homositeïen; Rooisel Folaat; Serum Vitamien B12; Fibrinogeen; Gamma glutermyl transferases (GGT); Carbohydrate-deficient transferrin (CDT); Ferritin; Uriensuur; Kreatinien; C-reactiewe proteïen; Albumien; Pre-albumien; Transferrien; Retinol-binding proteïen; TSH; Jodium (uriene); Leptien; Tumor Nekrosis Faktor alfa; Interleuken 6; Melatonien; Brain natriuretic peptide; ACTH; Kortisol; Orexin; Urotensien-11; Endothelien 1; Plasminogen Activation Inhibitor (PAI-1); Adiponektien; Mikro-albumienuria (uriene); Glukose toleransie (sub-sample); FFA (sub-sample).
'n Kort mediese ondersoek sal ook gedoen word op sekere lede van die huishouding om ernstige gesondheidsprobleme te identifiseer.

Ons wil graag van die bloed bêre vir moontlike toekomstige navorsing wat verband hou met die huidige navorsingsvrae. Bloed monsters sal anoniem gestoor word vir 'n periode van vyf jaar by die Departement Chemiese Patologie by die Universiteit van die Vrystaat. As u ongelukkig daaroor voel dat u bloed vir toekomstige navorsing geberg word sal daar aan die einde van die studie daarmee weggedoen word sodra die monsterbergings- en aantekeningsvereistes van goeie navorsingspraktyk nagekom is.

Dit is baie belangrik dat ons inligting van ‘n hoë kwaliteit versamel. Omdat MIV/VIGS ‘n siekte is wat amper alle aspekte van gesondheid beïnvloed, is dit nodig dat ons weet of MIV afwesig is voordat ons die data ontleed. Dit sal tot voordeel van uself en die navorsing strek indien u HIV status bepaal kan word. Dus sal ons toestemming vra om bloed te trek om u MIV status te bepaal en vrae oor HIV vra wat u nie hoef te antwoord indien u nie wil nie. U sal gevra word om ‘n aparte teostemmingsvorm te voltooi vir die HIV toets. U sal voor en na die toets berading ontvang deur ‘n mediese dokter en alle uitslae sal streng vertroulik hanteer word volgens die riglyne van die Health Professions Council of South africa (HPCSA). U sal slegs van u MIV uitslae in kennis gestel word indien u kies om dit te ontvang. Alle respondente wat kies om van hulle uitslae in kennis gestel te word sal deur ‘n mediese dokter in kennis gestel word en verwys word vir die relevante hantering. Die navorsers (met uitsluiting van een dokter) sal nie weet wat u uitslae is nie.

Bloedtoetse sal die analise van die genetiese samestelling van rooibloedselle insluit en is gemik daarop om die oorsake en gevolge van chroniese siektes soos vetsug, diabetes en hartsiektes beter te verstaan. Gene is dit wat u van u ouers erf en word in elke deel van u liggaam aangetref. Daarom sal dit in enige weefsel of bloed wat deur ons verwyder word teenwoordig wees. Die bevindings kan tot ander se voordeel strek met betrekking tot voorkoming en behandeling van die toestand. Dit staan u vry om toestemming te weier en u hoef geen redes daarvoor te verstrek nie. Die volgende reëlings is getref om privaatheid en vertroulikheid van u genetiese inligting te verseker: Alle bloedmonsters sal anoniem geberg word by Departement Chemiese Patologie by die Universiteit van die Vrystaat. U genetiese materiaal en inligting sal in ‘n identifiseerbarevorm gebruik word. Die navorsing mag inligting openbaar wat van potensiële belang mag wees vir die toekomstige gesondheid van ‘n identifiseerbare of potensieel identifiseerbare deelnemer of die deelnemer se nakomelinge.

Navorsers sal poog om inligting oor die uitkoms van die navorsing te verskaf. As navorsing inligting aan die lig bring wat van belang mag wees vir die gesondheid van u familielede, sal u toestemming verkry word voordat sodanige inligting aan die betrokke familielede bekend gemaak word. U bloed en inligting sal nie sonder toestemming vir ander gebruike beskikbaar gestel word nie tensy vereis deur die wet.

Risikos van deelname aan die studie: Mediese dokters of geregistreerde verpleegkundiges sal verantwoordelik wees vir die veilige neem van bloedmonsters. In die onwaarskynlike geval dat ‘n negatiewe gevolg ontstaan as gevolg van die prosedure sal u vir enige onkostes vergoed word.
Voordele van deelname aan die studie: Deur aan die studie deel te neem sal u ons help om gesondheids- en voedingstrategieë te ontwikkel wat die mense van die Vrystaat sal baat. Die proefpersoon sal pertinente inligting oor die studie ontvang tydens betrokkenheid by die projek en agterna wanneer die resultate beskikbaar is.

Deelname is vrywillig, en weiering om deel te neem sal geen boete of verlies van voordele waarop die deelnemer andersins geregtig is behels nie; die proefpersoon kan te eniger tyd aan deelname onttrek sonder boete of verlies van voordele waarop die proefpersoon andersins geregtig is.
Vertroulikheid: Daar sal gepoog word om persoonlike inligting vertroulik te hou. Volkome vertroulikheid kan nie gewaarborg word nie. Persoonlike inligting kan bekend gemaak word as die wet dit vereis. Organisasies wat u navorsingsrekords mag ondersoek en/of kopieer vir kwaliteitsversekering en data-analise sluit groepe soos die Etiekkomitee vir Mediese Navorsing en die Medisynebeheerraad in. As resultate gepubliseer word kan dit lei tot individuele/groepsidentifikasie.

Vriendelike groete

Dr CORINNA WALSH
Kontakbesonderhede: 083 297 6030 / 051 4013818(W)

Assuring Health for All (AHA) in the Free State
(Tshepiso ya Bophelo ho bohle ba Foreisitata)

TUMELLO YA HO NKA KAROLO DIPATLISISONG

O kopuwe ho nka karolo dipatlisisong.

O tsebisitswe ka dipatlisiso tsena ke .....

O ka ikopanya le Dr Corinna Walsh ho 083 297 6030 nako e nngwe le e nngwe ha o na le dipotso ka dipatlisiso kapa ha o ka wa lematseha ka lebaka la dipatlisiso.

O ka ikopanya le mongodi wa komiti ya Ethics ho Faculty ya Health Sciences, Yunivesithing ya Foreisitata nomorong ya (051) 4052812 ha o ena le dipotso ka ditokelo tsa hao jwalo ka motho ya nkang karolo dipatlisisong.

O nka ka karolo dipatlisisong ka ho ithaopa, ka hoo o ke ke wa ahlolwa kapa wa lahlehelwa ke di letho ha o ka wa hana ho nka karolo kapa wa tlohella ho nka karolo.

Ha ebe o dumela ho nka karolo, o tla fuwa lengolo le tshwanang le lena le saenuweng hammoho le lengolo le fanang ka tlhahiso leseding, eo e leng tlhaloso e ngotsweng ya dipatlisiso tsena.

Ke hlaloseditswe sepheo sa dipatlisiso, hammoho le tlhahiso leseding ena e ka hodimo ka molomo. Ke utlwisisa ho nka karolo ha ka dipatlisisong mme ke dumela ho nka karolo ka ho ithaopa, ntle le ho qobellwa.

_____ _____
Signature ya ya nkang karolo Letsatsi

Bakeng sa bana

_____ _____
Signature ea ngoana Letsatsi

_____ _____
Signature ea motsoali Letsatsi

Assuring Health for All (AHA) in the Free State
(Tshepiso ya Bophelo ho bohle ba Foreisitata)

LENGOLO LA TLHAHISO LESEDING

Sehloho sa dipatlisiso: Assuring Health for All in the Free State

Re leboha ha o dumetse ho re thusa dipatlisisong tsena tse bohlokwa. Re tshepa ha dipatlisiso di tla re thusa ho ntlafatsa maphelo a batho bohle ba Foreisitata.
Rona, re le Yunivesithi ya Foreisitata, Lefapha la tsa Maphelo, re etsa dipatlisiso ho shebana le dintho tse bakang mafu le boqhwala mona Foreisitata e Borwa.
Dipatlisiso ke mokgwa wa ho ithuta karabo ya potso e itseng. Ka dipatlisiso tsena re batla ho ithuta hore na ke dintho dife tse hlokang hore di amuwe ditsamaisong tsa tsa bophelo mona Foreisitata. Tsena ke dipatlisiso feela, mme ha se karolo ya tshebeletso ya tsa bongaka.

Sememo sa ho nka karolo: Re a o kopa/ re a o mema ho nka karolo dipatlisisong tsena, ebile/ kapa re kopa tumello ya hao ho sebedisa ngwana wa hao dipatlisisong tsena.
Dipatlisiso tsena di kenyeleditse eng: Sepheo sa dipatlisiso tsena ke ho fumana tlhahiso leseding e lekaneng mabapi le tswello pele ya mafu a kang diabetes, stroke, high blood pressure le mafu a pelo hammoho le HIV/AIDS hore ho tle ho thalwe mekgwa ya tsamaiso ya tsa bophelo le phepo bakeng sa batho ba Foreisitata. Trompsburg, Phillippolis le Springfontein di kgethilwe jwalo ka dibaka tsa mahaeng mme Mangaung e kgethilwe e le sebaka sa ditoropong tse tla sebediswang dipatlisisong.
Bakeng sa dipatlisiso tsena re hloka ho sebetsa le malapa ohle motseng wa lona bakeng sa dilemo tse 12. Dipatlisiso tsa pele di tla qala ka Hlakubele (March) 2007 ho isa ho Pudungwana (November) 2007. O tla kopuwa ho etela sebaka seo lipatlisiso tsena li tswaretsoeng teng letsatsi le le leng hore o tle o tsebe ho tlatsa diforomo le hore o methuwe. Kamora dipatlisiso tsena tsa pele, ho kenywa tshebetsong mekgwa ya tlhokomelo mabapi le tsa phepo sebakeng seo o dulang ho sona hore ho tle ho lokisanwe le mathatha a tla be a hlahelletse dipatlisisong tsa pele. Tlhokomelo ena e tla ba karolo ya ho ithuta ho bile ho fanwa ka ditshebeletso ke baithuti ba Yunivesithi. Hammoho le ditshebetso tseo re tla be re fana ka tsona motseng, re tla etela motse wa hao ka mora dilemo tse tharo hoisa ho tse tseletseng hore ho phethwe ho metha.

Diforomo tsohle di tla tlatswa sebakeng seo liphuputso li tla tswareloa teng ke baithuti ba tswang Yunivesithing ya Foreisitata kapa ke bathusi ba kwetlisitsweng ba tswang motseng wa hao. Batho ba nkang karolo ho tswa malapeng a kgethilweng ba tla kopuwa ho tlatsa diforomo tse latelang ho ya ka dipotso tseo ba tla beng ba di botswa ke moithuti kapa mosebeletsi wa setjhaba:

- Dipotso ka maemo a hao le ka lelapa la hao,
- Theko ya dijo le 'food security',
- Tsebo, tshebetso le mekgwa e amanang le phepo,
- Tsela ya ho ja le boikwetliso.

Re tla o metha boima, botelete, botenya ba momeno wa letlalo (skinfold) le kgatello ya madi (blood pressure), o tla nkuwa madi hammoho le metsi. Ho batho ba baholo re tla hula madi a kana ka dimililitara tse 60, mme ho bana re tla hula tse 15, hona ho tla etswa hanngwe feela. Ho tla etswa dihlahlobo tsa bophelo ho batho ba itseng ba lelapa ho shebana le mathata a bophelo a tshosetsang. Ka tumello ea hau re tla ntsa madi a ka bang dimelimetara tse mashome a tseletseng (60ml) ho motho e moholo le tse leshome le metso e mehlano (15ml) ho bana , mme hona ho tla etwa hangoe feela. Madi le metsetse e nkuoeng ho batho ba baholo e tla sebediswa ho hlalhoba matsoai le matsooeana a fumanehang ho tsona a kenyeletsang tse latelang: Full blood count; HbA1c; Glucose; Insulin; Lipogram; Homocysteine; Red cell Folic acid; Serum Vitamin B12; Fibrinogen; Gamma glutermyl transferases (GGT); Carbohydrate-deficient transferrin (CDT); Ferritin; Uric acid; Creatinin; C-reactive protein; Albumin; Pre-albumin; Transferrin; Retinol-binding protein; TSH; Iodine (urine); Leptin; Tumour Necrosis Factor alpha; Interleuken 6; Melatonin; Brain natriuretic peptide; ACTH; Cortisol; Orexin; Urotensin-11; Endothelin 1; Plasminogen Activation Inhibitor (PAI-1); Adiponectin; Micro-albuminuria (urine); Glucose tolerance (sub-sample); FFA (sub-sample). Tse ding tsa matsoai le matsoaeana ana di tla hlahlojoa mading le metsetseng ea bana
Re ka rata ho boloka a mang a madi hore a tle a tsebe ho sebediswa ka nako e tlang dipatlisisong tse tshwanang le tsena. Madi ana a tla bolokwa kantle le ho ngolwa mabitso bakeng sa dilemo tse hlano

Lefapheng la Chemical Pathology Yunivesithing ya Foreisitata. Ha o sa rate ha madi a hao a bolokwa bakeng sa dipatlisiso tse ding, a tla lahlwa ha ho qetwa ka dipatlisiso le hang feela ha a ile a bolokwa hantle e bile dintho tse hlokahalang bakeng sa dipatlisiso di ile tsa fumanwa ka mokgwa o nepahetseng.

Ho bohlokwa haholo hore tlhahiso leseding eo re e fumanang ke e hlwahlwa. Hobane lefu la HIV e le le hlokofatsang haholo, ebile le ama maphelo a rona, ho a hlokahala hore re tsebe hore kokwana-hloko ena e teng kapa tjhe. Ke molemong oa hau le oa mofuputse ho fumana boemo ha hau ba HIV. Ka hona re tla kopa tumello ea ho ntsa madi ho uena ho ea hlahloba boemo ba hau ba HIV mme re tla u botsa lipotso tse ling tse amanang le boemo ba hau ba HIV tseo u sa qobelloeng ho li araba. U ka li araba ka ho rata ha hau. U tla kopuoa ho saena foromo eo u re fang tumello ea ho hlahloba boemo ba hau ba HIV. Ka hoo re tla hula madi le ho o botsa dipotso mabapi le maemo a hao a HIV. O dumelletswe ho se arabe dipotso tsena. Ho tla buisanwa le wena ho tebesitswe maikutlo pele le ka mora dihlahlobo tse tla etswa ke ngaka, mme diphetho tsohle di tla ba sephiri ho ya ka ditaelo tsa Health Professions Council ya South Africa (HPCSA). O tla tsebiswa ka maemo a hao a HIV feela ha o kgetha hore o tsebiswe. Batho bohle ba batlang ho tsebiswa ka sephetho sa dihlahlobo tsa HIV, ba tla tsebiswa ke ngaka, mme ba tla romellwa ho batho ba tla tseba ho ba fa thuso. Babatlisisi ba bang (ka ntle ho dingaka) ba ke ke ba tseba maemo a ba nka karolo a HIV.

Ho hulwa ha madi ho kenyelleditse ho hlahloba 'genetic composition' e ho di 'red blood cells', mme hona ho tla thusa ho phahamisa kutlwisiso ya dintho tse bakang mafu a kang monono, diabetes le mafu a pelo. Di 'genes', ke dintho tseo o di futsang ho tswa ho batswadi ba hao. Di fumanwa dikarolong tsohle tsa mmele kahoo di a fumaneha le ho madi a tla hulwa. Dintlha tse tla fumanwa di tla thusa batho ba bang ka ho thusa ho thibela, kapa ho phekola mafu a fapaneng. O na le tokelo ya ho hana ho nka karolo ebile ha ho hlokahale hore o fane ka lebaka. Ho netefatsa hore dintlha tse tla fumanwang ho wena di dula e le sephiri, ho entswe dintho tsena tse latelang: Madi ohle a tla bolokwa ntle le ho ngolwa mabitso Lefapheng la Chemical Pathology Yunivesithing ya Foreisitata. 'Genetic material' ya hao e tla sebediswa ka mokgwa o tsebahalang. Dipatlisiso tsena di ka nna tsa fana ka tlhahiso leseding e bohlokwa bakeng sa bokamoso ba monka karolo kapa ba bana ba hae.

Babatlisisi ba tla leka ho fana ka lesedi mabapi le sephetho sa dipatlisiso. Ha dipatlisiso di ka fana ka dinthla tse leng bohlokwa bakeng sa maphelo a ba bang ba lelapa, tumello e tla kopuwa ho wena pele batho ba amehang ba tsebiswa. Dintlha tsohle tsa hao di ke ke tsa sebediswa nqeng tse ding kantle ho tumello ya hao, kantle le ha ho ka hlokeha hore ho etswe jwalo ho ya ka molao.

Kotsi tse ka bang teng dipatlisisong: Dingaka le baoki ba tla ikarabella ho huleng ha madi ka mokgwa o bolokehileng. Ha ho ka etsahala hore ho be le se o etsahallang se sa lokang o tla lefuwa ditshenyehelo tsa hao tsohle.
Ditholwana tsa ho nka karolo: Ha o nka karolo o tla thusa ho tsweletsa pele metjha ya tsa bophelo le phepo ho thusa batho ba Foreisitata. O tla fuwa tlhahiso leseding e bohlokwa tsamaong ya dipatlisiso le ha sephetho sa dipatlisiso se fumaneha.

O nka karolo ka ho ithaopa, mme ha o hana ho nka karolo o ke ke wa lahlehelwa ke letho; o ka tlohella ho nka karolo nako e nngwe le e nngwe ntle le ho lahlehelwa ke letho.
Sephiri: Ho tla etswa maleba-leba a hore dintlha tsa hao di dule di le lekunutu. O tshepiswa lekunutu ka hohle-hohle. Dintlha tsa hao di phatlalatswa feela ha molao o re jwalo. Mekgatlo e tla hlahloba kapa e tla kopisa dintlha tsa hao ho lekola boleng e kenyeleditse e kang Ethics Committee ya Medical Research hammoho le Medicine Control Council.
Ha diphetho di ka phatlalatswa, hona ho ka lebisa ho tsebiswa ha motho kapa sehlopha.

Ka boikokobetso
Dr Corinna Walsh
Mohala: 083 297 6030 / 051 401 3818

APPENDIX J

Assuring Health for All (AHA) in the Free State
Participation letter

Dear Participant
Thank you for being willing to help us in this very important project. We are sure that the project will contribute to improving the health of all the people of the Free State.
At the time you receive this letter you would have already been visited by a fieldworker and you have already signed consent to give a blood sample. This letter serves to inform you of the date and time the blood sample and other measurements will be taken at the research unit (hall) closest to your household.

IMPORTANT INFORMATION

1. You must be at the research unit (hall) in your community on **…….** by 0….h00.
2. You **MUST NOT EAT OR DRINK** anything after ten o'clock of the previous night (10 pm of the night before). This is necessary for the glucose test to be accurate.
3. You **MUST BRING YOUR ID DOCUMENT** with you
4. You will receive something to eat and drink after the blood sample is taken.
5. If you are employed, please show this letter to your employer.

Dear Employer
This serves to ask you to give one day's paid leave to……. in order to allow him/her to attend his appointment with the research team of the Faculty of Health Sciences at the University of the Free State. Thank you for your cooperation. For any further information please contact Dr Corinna Walsh at 083 297 6030.

C Walsh (project leader)

Assuring Health for All (AHA) in the Free State
Deelname brief

Beste Deelnemer
Dankie dat u bereid is om ons te help met hierdie belangrike projek. Ons is seker dat die projek sal bydra tot die verbetering van gesondheid van al die mense in die Vrystaat.
Teen die tyd wat u hierdie brief ontvang het ‘n veldwerker u al reeds besoek en u het toestemming gegee om deel te neem aan die projek en ‘n bloed monster te gee Met hierdie brief wil ons u graag in kennis stel van die datum en tyd wat die bloed getrek sal word en ander mates geneem sal word by die navorsingseenheid (saal)naaste aan u woning.

BELANGRIKE INLIGTING

1. U moet by die navorsingseenheid (saal) in u gemeenskap wees op **…….** teen 0….h00.
2. U **MOET NIKS EET OF DRINK** na tien uur die vorige aand (10 pm van die aand voor die toets). Dit is nodig vir die glukose toets om betroubaar te wees.
3. U **MOET U ID DOKUMENT** saam met u kliniek toe bring
4. U sal ‘n ligte ete en iets om te drink ontvang nadat die bloedtoets voltooi is.
5. Indien u werk, moet u asseblief hierdie brief aan u werkgewer wys.

Geagte Werkgewer
Met hierdie brief vra ons dat u een dag betaalde verlof toestaan aan……. om dit vir haar/hom moontlik te maak om hierdie afspraak met die navorsingsspan van die Fakulteit Gesondheidswetenskappe by die Universiteit van die Vrystaat by te woon.
Dankie vir u samewerking. Vir verdere inligting kontak asseblief vir Dr Corinna Walsh by 083 297 6030.

C Walsh (projekleier)

Assuring Health for All in the Free State
(Tshepiso ya Bophelo ho bohle ba Foreisitata)

Lengolo la ho nka karolo

Ho ya nkang karolo
Re leboha ha o dumetse ho re thusa mosebetsing ona o bohlokwa. Re tshepa ha mosebetsi ona o tla thusa ho ntlafatsa maphelo a batho bohle ba Foreisitata.
Nako eo o fumanang lengolo lena, o tla be o se o etetswe ke e mong wa bathusi ba rona ebile o tla be o se o saenile ho fana ka tumello ya ho hula madi. Lengolo lena ke le o tsebisang ka letsatsi le nako eo tla methwang le ho hulwa madi tliliniking e haufi le lelapa la hao.

DINTLHA TSA BOHLOKWA

1. O tlamehile o be o le tliliniking e motseng wa hao ka di ..... nako e le 0.....h00.
2. **O SE KE WA JA KAPA WA NWA** letho ka mora hora ya leshome(10:00) bosiu bo ka pele ho fihlela o hlahlobuwa tliliniking. Hona ho bohlokwa hore dihlahlobo tsa tswekere e be tse nepahetseng.
3. O **TSHWANETSE HO TLA LE BUKANA YA HAO YA BOITSEBISO (ID)** ha o tla
4. O tla fuwa tjhelete e nyenyane bakeng sa ditshenyehelo tse tla bang teng hore o nke karolo dipatlisisong. O tla fumana dijo kamora hore o hulwe madi.
5. Ha e be o sebetsa, re kopa o bontshe monga hao lengolo lena.

Monga mosebetsi
Lengolo lena le kopa hore of fane ka letsatsi le leng leng le patallwang ho ..... hore a tle a tsebe ho ba teng ka nako eo a e beetsweng bakeng sa sehlopha se etsang dipatlisiso sa Lefapha la tsa maphelo Yunivesithing ya Foreisitata.
Re lebohela tshebedisano mooho ya hao. Ha ebe o hloka tlhalosetso e fetang mona o ka ikopanya le Dr Corinna Walsh ho 083 297 6030.

C Walsh (moetelledipele)

APPENDIX K
Antiretroviral Therapy Treatment Guidelines

Adults and Adolescents

Standardised national eligibility criteria for starting ART regimes for adults and adolescents (DoH, 2013).

Eligible to start Lifelong ART
▪ CD4 count ≤ 350 cells/mm3 irrespective of WHO clinical stage **OR** ▪ Irrespective of CD4 count o All types of TB (in patients with TB drug resistant or sensitive, including extra pulmonary TB) ▪ WHO stages 3 or 4 irrespective of CD4 count
Require fast track (i.e. ART initiation within 7 days of being eligible)
▪ HIV positive women who are pregnant or breast feeding OR ▪ Patients with low CD4 < 200 OR ▪ Patients with Stage 4, irrespective of CD4 count **OR** ▪ Patients with TB/HIV co morbidity with CD4 count < 50 (Patients with Cryptopcoccus meningitis or TB meningitis (defer RT for 4-6 weeks)
Patients with CD4 above 350, not yet eligible for ART
▪ Transfer to a wellness programme for regular follow-up and repeat CD4 testing 6-monthly. ▪ Advise on how to avoid HIV transmission to sexual partners and children. ▪ Initiate INH prophylaxis if asymptomatic for TB. ▪ Provide counseling on nutrition and contraception and do annual pap smear.

3TC Lamivudine
ABC Abacavir
AZT Zidovudine
d4T Stavudine
EFV Efavirenz
FTC Emtricitabine
LPV/r Lopinavir/ritonavir
NVP Nevirapine
TDF Tenofovir

Standardised national ART regimens for adults and adolescents (DoH, 2013)

1st Line		
All new patients needing treatment, including pregnant women	TDF + FTC (or 3TC) + EFV	Replace EFV with NVP in patients with significant psychiatric co morbidity or intolerance to EFV and where the neuro-psychiatric toxicity of EFV may impair daily functioning, e.g. shift workers.
Adolescents	ABC + 3TC + EFV	At age 18 years an adolescent if eligible must be

		switched to the FDC.
Contraindications to EFV	TDF + (FTC or 3TC) + NVP	Use NVP based regimen in patients with significant psychiatric co morbidity or intolerance to EFV and where the neuro-psychiatric toxicity of EFV may impair daily functioning, e.g. shift workers.
Contraindications to TDF	AZT + 3TC + EFV (or NVP)	Renal disease or the use of other nephrotoxic drug, e.g. aminoglycosides.
Contraindications to TDF and AZT	D4T + 3TC + EFV (or NVP)	Renal disease and anaemia or the use of other nephrotoxic drugs, e.g. aminoglycosides.
Contraindications to TDF, AZT and d4T	ABC + 3TC + EFV (or NVP)	Renal disease, anaemia, peripheral neuropathy, the use of other nephrotoxic drugs.
Currently on d4T-based regimen	TDF + FTC (or 3TC) + EFV FDC preferred	Mandatory if patients experience toxicity and patients who are at high risk of toxicity (high BMI) or pregnant). Switch to TDF if virally suppressed and the patient has normal creatinine clearance, even if well tolerated.
2nd Line		
Management of virological failure		Of plasma HIV RNA > 1000 copies. Check for adherence, compliance, tolerability and drug-drug interaction and assess psychological issues. Repeat VL test 2 months later. If plasma VL confirmed >1000 copies change regime to 2nd line therapy.
Failing on a TDF-based 1st line regimen	AZT + 3TC = LPV/r	Patients with anaemia and renal failure switch to ABC.
Failing on a d4T-based 1st line regimen	TDF + 3TC (or FTC) and LPV/r	
Dyslipidaemia or intractable diarrhoea associated with LPV/r	Switch LPV/r to ATV/r	
3rd Line		
Failing 2nd line regimen	Specialist referral	
Should be expert and genotype resistance testing based decision and supervised care. Patients failing on 2nd line therapy will be managed by an expert panel. The drugs for 3rd line will be managed centrally. More discussion is required to deal with the modalities.	Most likely regimen: Raltegravir/Darunavir/Etravirine adjusted according to genotype interpretation. Should be by expert and take into account prior exposure and predictable mutations.	

Standardised national monitoring for adults and adolescents with HIV (DoH, 2013)

At initial diagnosis of HIV	Purpose
Confirm HIV result with rapid antibody test	Ensure that national testing algorithm has been followed
Do CD4 count of HIV positive and WHO clinical staging	To assess eligibility for ART To access eligibility for fast-tracking
Screen for pregnancy or ask if planning to conceive	To identify women who need ART for life or ARV prophylaxis for PMtCT
Screen for TB symptoms using the WHO questionnaire	To identify TB/HIV co-infected
Do the CD4 count on the same day	To identify for ART or ARVs for prophylaxis if pregnant
Do HB or FBC if requires AZT Creatinine if requires TDF For patients initiated on NVP based regime do ALT	To detect anaemia or neutropenia To detect renal insufficiency To exclude liver disease

On ART	Purpose
CD4 at 1 year on ART	To monitor immune response to ART
VL at months 6, 1 year on ART and then every 12 months	To identify treatment failures and problems with adherence
ALT only if on NVP and develops rash or symptoms of hepatitis	To identify NVP toxicity
FBC at month 3 and 6 if on AZT	To identify AZT toxicity
Creatinine at month 3 and 6, 1 year then every 12 months if on TDF	To identify TDF toxicity
Fasting cholesterol and triglycerides at months 3 if on LPV/r	To identify LPV/r toxicity

At routine follow-up visits for those not yet eligible for ART	Purpose
Repeat CD4 count at 6 months	To see if they have become eligible for ART
WHO clinical staging at every visit	To see if they have become eligible for ART
Screen for TB symptoms to identify TB suspects Offer IPT if no TB symptoms	To identify TB/HIV co-infection To prevent TB activation
Offer prevention for HIV positives	To prevent HIV transmission and re-infection To prevent STIs

Indications for urgent up-referral prior to initiation or when on therapy

- eGFR less than 60 ml/min
- Hb less than 8 g/dl
- BMI less than 18.5 kg/m^2
- In patient with TB or other opportunistic infection, poor response to TB or OI treatment

APPENDIX A: Assuring Health for All (AHA) in the Free State

SOCIO-DEMOGRAPHIC AND HOUSEHOLD QUESTIONNAIRE

(All information in this questionnaire is confidential).

Town:_____ 1

Household number: 2-5

Member number: 6-7

Interviewer: _____ 8-9

Interview Date: D D M M Y Y Y Y 10-17

For each individual living in the household (5-7 days per week), provide the following:

Household Member		Name	Relation to head of household	Sex	Education	Birth date D D M M Y Y Y Y	
0	1	_____					18-31
0	2	_____					32-45
0	3	_____					46-59
0	4	_____					60-73
0	5	_____					1-14
0	6	_____					15-28
0	7	_____					29-42
0	8	_____					43-56
0	9	_____					57-70
1	0	_____					1-14
1	1	_____					15-28
1	2	_____					29-42

For each individual who was living in the house and died within the past 2 years, provide the following:

Name	Relation	Sex	Education	Birth date D D M M Y Y Y Y	
_____					43-54
_____					55-66
_____					67-78
_____					1-12

Household member number of person with whom interview is being conducted: 13-14

How many years have you been living in a rural area (at least 30km away from big city)? 15-16

Encircle the appropriate answer:

First language of household: ☐ 17

1. Sotho
2. Tswana
3. English
4. Afrikaans
5. Other, specify_____

Employment status of respondent: ☐ 18

1. Housewife by choice
2. Unemployed
3. Self Employed
4. Full time wage earner (receive a salary)
5. Other, specify (part-time, piece job etc.)_____
6. Don't Know

Husband/ partner's employment status: ☐ 19

1. Retired by choice
2. Unemployed
3. Self Employed
4. Full time wage earner (receive a salary)
5. Other, specify (part-time, piece job etc.)_____
6. Not Applicable e.g. dead

Type of dwelling: ☐ 20

1. Brick, Concrete
2. Traditional mud
3. Tin
4. Plank, wood
5. Other, specify_____

Total number of rooms in house: _____ ☐☐ 21-22

Number of bedrooms: _____ ☐ 23

Do you have a bathroom in the house? 1=Yes 2=No ☐ 24

Do you have a bathroom outside? 1=Yes 2=No ☐ 25

Do you have a kitchen or cooking area inside the house? 1=Yes 2=No ☐ 26

Does the household have electricity? 1=Yes 2=No ☐ 27

Where do you get drinking water most of the time? ☐ 28

1. Own tap
2. Communal tap
3. River, dam
4. Borehole, well
5. Other, specify _____

What type of toilet does this household have? ☐ 29

1. Flush
2. Pit
3. Bucket, pot
4. VIP
5. Other, specify _____

What fuel is used for cooking most of the time? ☐ 30

1. Electric
2. Gas
3. Parrafin
4. Wood, Coal
5. Sun
6. Open fire

Do you use a cast iron pot for cooking? ☐ 31

1. Never
2. ≤ Once a week
3. > Once a week
4. Every day

Does the home have a working:

Refrigerator and/or freezer ☐ 32
1.Yes
2.No

Stove (Gas, Coal or electric) or Hot Plate ☐ 33
1. Yes
2. No

Primus or Paraffin Stove ☐ 34
1. Yes
2. No

Microwave ☐ 35
1. Yes
2. No

Radio ☐ 36
1. Yes
2. No

Television ☐ 37
1. Yes
2. No

How many people contribute to the total income? _____ ☐☐ 38-39

Household income per month (including wages, rent, sales of vegs, etc. State grants). ☐ 40
1. None
2. R100-R500
3. R501- R1000
4. R1001-R3000
5. R3001-R5000
6. Over R5000
7. Don't know

Is this more or less the income that you had over the past six months? ☐ 41

1. More
2. Less
3. The same

Race of the family: ☐ 42
1. Black
2. Coloured
3. White
4. Mixed

Codes to be used for coding of questionnaires:

Level of education:

1. None
2. Primary School
3. Std 6-8
4. Std 9-10
5. Tertiary Education
6. Don’t Know

Relation to head of the household:

1. Head of the household
2. Spouse
3. Child
4. Sibling
5. Mother/ Father
6. Mother-in-law/ Father-in-law
7. Grandchild
8. Daughter-in-law/ Son-in-law
9. No relation
10. Other

Gender:

1. Male
2. Female

APPENDIX B: Assuring Health for All (AHA) in the Free State

HOUSEHOLD FOOD SECURITY AND FOOD PROCUREMENT QUESTIONNAIRE

(All information in this questionnaire is confidential).

Town:_____ | | 1

Household number: | | 2-5

Member number (as on socio-demographic form): | | 6-7

Interviewer: _____ | | 8-9

Interview Date: D D M M Y Y Y Y | | 10-17

How much money is spent on food for the household weekly? | | 18-19

1. R0-R50
2. R51-R100
3. R101-R150
4. R151-R200
5. R201-R250
6. R251-R300
7. R301-R350
8. R351-R400
9. Over R400
10. Don't know

What is your main source of income? | | 20

1. wages and salaries from formal employment
2. self employment (including home enterprises)
3. casual employment (agricultural or non agricultural)
4. crop production and livestock sales
5. sale of assets
6. land/ flats /equipment rental
7. old age pension or state grant
8. domestic work
9. other: specify _____

FOOD PRODUCTION, PRESERVATION AND AVAILABILITY

Do you grow vegetables? 1=yes 2=no | | 21

If yes, which vegetables do you produce?

1. Cabbage | | 22
2. Carrots | | 23
3. Green, leafy vegetables | | 24
4. Pumpkin | | 25
5. Beans | | 26
6. Beetroot | | 27
7. Other: specify _____ | | 28

Do you grow crops? 1=yes 2=no | | 29

If yes, which crops do you produce?

1. Maize | | 30
2. Wheat | | 31
3. Sorghum | | 32
4. Potatoes | | 33
5. Other: specify _____ | | 34

What % of the annual agricultural yield is sold? _____ | | 35-37

Do you have your own fruit trees? 1=yes 2=no ☐ 38

If yes, what fruit do you grow?

1. Peaches ☐ 39
2. Appricots ☐ 40
3. Grapes ☐ 41
4. Apples ☐ 42
5. Oranges ☐ 43
6. Other: specify _____ ☐ 44

Do you own livestock? 1=yes 2=no ☐ 45

If yes, which livestock do you own and how many?

1. Beef cattle, specify how many_____ ☐☐☐☐ 46-49
2. Dairy cattle , specify how many_____ ☐☐☐☐ 50-53
3. Sheep, specify how many_____ ☐☐☐☐ 54-57
4. Goats, specify how many_____ ☐☐☐☐ 58-61
5. Pigs, specify how many_____ ☐☐☐☐ 62-65
6. Chickens, specify how many_____ ☐☐☐☐ 66-69
7. Other: specify _____ ☐☐☐☐ 70-73

Do you usually produce enough food to last until the next season? 1=yes 2=no ☐ 74

If yes, which food usually lasts until the next harvest? 1=yes 2=no

1. vegetables ☐ 75
2. crops ☐ 76
3. fruits ☐ 77
4. other: specify _____ ☐ 78

If not, what are the reasons ☐ 79

1. not enough land
2. not enough money to buy seeds and other equipment
3. other: specify _____

Do you keep food for future use? 1=yes 2=no ☐ 80

If yes, which method do you mostly use? ☐ 1

1. sun drying
2. canning
3. freezing
4. other: specify_____

What is your main reason for producing food? ☐ 2

1. consumption by family members
2. to sell
3. to exchange for clothes and household equipment
4. other: specify_____

Are fruits easily available from the local farmers and shops? 1=yes 2=no ☐ 3

Are vegetables easily available from the local farmers and shops? 1= yes 2=no ☐ 4

What form of transport do you mainly use to buy food? ☐ 5

1. Foot
2. Bicycle
3. Public transport e.g. taxi
4. Car
5. Other _____

Who in the family is served first when meals are served? ☐ 6

1. Father/ men in the family
2. Mother/ women in the family
3. Children
4. All eat at the same time
5. Lives and eats alone

HUNGER SCALE

Does your household ever run out of money to buy food? ☐ 7
1. yes
2. no

Do you ever rely on a limited number of foods to feed your children? ☐ 8
1. yes
2. no

Do you ever cut the size of meals or skip any because there is not enough food in the house? ☐ 9
1. yes
2. no

Do you ever eat less than you should because there is not enough money for food? ☐ 10
1. yes
2. no

Do you your children ever eat less than you feel they should because there is not enough money for food? ☐ 11
1. yes
2. no

Do your children ever say they are hungry because there is not enough food in the house? ☐ 12
1. yes
2. no

Do you ever cut the size of your children's meals or do they ever skip meals because there is not enough money to buy food? ☐ 13
1. yes
2. no

Do any of your children ever go to bed hungry because there is not enough money to buy food? ☐ 14
1. yes
2. no

Has the family ever experienced periods of food shortage? ☐ 15
1. yes
2. no

If yes, how did the family cope during this period? ☐☐ 16-17
1. Found other/additional sources of income
2. asked family/relatives/ neighbours for help (money/food)
3. family members went to live elsewhere
4. sold assets
5. worked for payment in kind
6. depended on charity/welfare
7. borrowed money/food
8. increased production of food
9. could not do anything
10. other: specify _____

APPENDIX C
Assuring Health for All (AHA) in the Free State

Dietary intake questionnaire 24-hour recall

Town: _____ | | 1

Household number: | | | | 2-5

Member number (as on socio-demo form): | | 6-7

Interviewer:_____ | | 8-9

Food and fluid intake (expressed in exchanges):

Food/Drinks and amounts	**Milk and milk products**	**Meat and meat alternatives**	**Legumes**	**Fruit ß-carotene**	**Vegetables ß-carotene**	**Fruit Vit C**	**Vegetables Vit C**	**Fruit other**	**Vegetables other**	**Bread and cereals**	**Fats and oils**	**Sweets/Sugar**	**Alcohol**
Breakfast and mid-morning													
Lunch and mid afternoon													
Supper and late night													
Total:													

Evaluation of dietary intake

	Quantity	Energy	Protein	CHO	Fat	Below requirement 1	Within requirement 2	Above requirement 3		
Milk and milk products		530	8	12	5					10
Meat and meat alternatives		315	7		5					11
Legumes		500	7	21	1					12
Soy beans		630	13	8	7					13
Fruit β-carotene		250		15						14
Vegetables β-carotene										15
Fruit vit C		250		15						16
Vegetables vit C										17
Fruit other		250		15						18
Vegetables B		150	2	7						19
Bread and cereal		285	3	15						20
Fats and oils		190			5					21
Sweets/Sugar		170		10						22
Alcohol										23
TOTAL										

Calculated estimated total values for:

Carbohydrate (g):						24-26
Protein (g):						27-29
Fat (g):						30-32
Energy (kJ):						33-37

Food frequency questionnaire

Number of times per day, per week or per month (only use one option)

Food	/day		/week		/month		
Sweets/ chocolates……..							38-43
Chips (crisp)……..							44-49
Cake/ biscuits……							50-55
Cool drinks……							56-61
Cremora……							62-67
Coffee……..							68-73
Tea……..							74-79
Sugar……..							1-6
Full-cream milk……..							7-12
Low fat/ skim milk……..							13-18
Eggs……							19-24
Peanut butter……							25-30
Soya mince/ legumes (baked beans, dried beans/peas, lentils)…..							31-36
Chicken……..							37-42
Red meat……							43-48
Fish……..							49-54
Bread……..							55-60
Porridge, cooked……..							61-66
Cereal (eg. Morevite/ Pronutro)……..							67-72
Samp/ mielie rice……..							73-78
Margarine/ oil/ fat……..							1-6
Fruit juice……							7-12
Fruit……							13-18
Vegetables……							19-24
Salt/ stock/ Royco……							25-30
Alcohol _____.....							31-36

Assuring Health for All (AHA) in the Free State
DIETARY DIVERSITY DATA FORM

Assuring Health for All (AHA)	Town: _____					1		
in the Free State	Household number:					2-4		
Dietary Diversity	Member number (as on socio-demo form)					5-6		
Questionnaire								
		YES=1		**Number of**				
Question number	**Food group**	**NO=2**		**exchanges**				
1	CEREALS		7			8-9		
2	WHITE ROOTS AND TUBERTS		10			11-12		
3	VITAMIN A RICH VEGETABLES AND TUBERS		13			14-15		
4	DARK GREEN LEAFY VEGETABLES		16			17-18		
5	OTHER VEGETABLES		19			20-21		
6	VITAMIN A RICH FRUITS		22			23-24		
7	OTHER FRUIT		25			26-27		
8	ORGAN MEAT		28			29-30		
9	FLESH MEAT		31			32-33		
10	EGGS		34			35-36		
11	FISH AND SEAFOOD		37			38-39		
12	LEGUMES, NUTS AND SEEDS		40			41-42		
13	MILK AND MILK PRODUCTS		43			44-45		
14	OILS AND FATS		46			47-48		
15	SWEETS		49			50-51		
16	SPICES, CONDIMENTS, BEVERAGES		52			53-54		
	Low DDS (≤ 3 food groups)	1				55		
	Medium DDS (4 and 5 food groups)	2						
	High DDS (≥ 6 food groups)	3						

Assuring Health for All (AHA) in the Free State

Exchange list calculation form

Town: _____ 1

Household number: 2-5

Member number: 6-7

Interviewer:_____ 8-9

Alcohol exchanges - Krause's Food, Nutrition and Diet Therapy, 2004. Ed. by Mahan KL & Escott S, 11th edition, Appendix 44, p. 1241.

Beverage	servings	Carbs	Protein	Fat	Energy
Beer					
Regular	336	**1 x15g +13**	**0**	**2x (0-1g)**	**x 150 kJ**
Light	336	**0 x 15g +5**	**0**	**2x (0-1g)**	**x 100 kJ**
Ciders	336	**1 x15g +12**	**0**	**0x (0-1g)**	**x 60 kJ**
Distilled spirits					
gin, rum, vodka, whiskey, scotch	42	**0 x15g**	**0**	**2x (0-1g)**	**x 100 kJ**
Dry brandy	28	**0 x15g**	**0**	**1.5 x (0-1g)**	**x 75 kJ**
Table wine					
Dry wine	112	**0 x 15 g+2**	**0**	**2x (0-1g)**	**x 80 kJ**
Red or Rosé	112	**0 x 15g +5**	**0**	**2x (0-1g)**	**x 85 kJ**
Sweet wine	112	**1/3 x 15g +1**	**0**	**2x (0-1g)**	**x 105 kJ**
Light wine	112	**0 x 15g**	**0**	**0x(0-1g)**	**x 50 kJ**
Sparkling wine	112	**1 x 15g+8**	0	**2x (0-1g)**	**x 116 kJ**

The energy contribution (in kilocalories) from an alcoholic beverage can be estimated by multiplying the number of grams of proof and then again by the factor 0.8. For beer and wine, energy can be estimated by multiplying grams by percentage of alcohol (by volume) and then by the factor 1.6

Appendices for dietary intake

Serving recommendations according to the Food Guide Pyramid (USDA, 1992)

	Adults	Children 2- to 6 –year-olds
Bread and cereal	6 – 11 servings /day	6 servings
Fruit	2 – 4 servings / day	2 servings
Vegetables	3 – 5 servings / day	3 servings
Meat and meat alternatives	2 – 3 servings / day	2 servings
Milk and milk products	2 – 3 servings / day	2 servings
Fats and sweets	Use sparingly	Use sparingly

ONE LEGUME PORTION PROVIDES:
21 grams of carbohydrates, 7 grams of protein, 0,7 grams of fat, and 500 kJ.

Split peas (Cooked)……..	½ cup (85g)
Chick peas (Dried & cooked)……	½ cup (85g)
Lentils (Whole; cooked)……	½ cup (90g)
Lentils (Split; cooked)……	½ cup (90g)
Sugar beans (Fried & cooked)……	½ cup (100g)
Kidney beans (White; Dried & cooked)……..	½ cup (90g)

Canned:

Baked beans in tomato sauce……..	⅓ cup (90g)
Kidney beans (White; solids & liquids)……	⅓ cup (90g)

Soybeans ..... ½ cup (80g)
Provides: 8 grams of carbohydrates, 13 grams of protein, 7 grams of fat, and 630 kJ.

PORTION SIZES –ADULTS

Grain group	**Fruit group**	**Meat group**
1 slice of bread	1 piece of fruit or melon wedge	30g of cooked lean meat, poultry, or fish.
½ cup of cooked rice or pasta	½ cup of juice	1 egg
½ cup of cooked porridge	½ cup of canned fruit	½ cup of cooked dry beans
½ cup of ready-to-eat cereal	½ cup of dried fruit	2 tablespoons of peanut butter (add one fat exchange)
1/3 cup samp		
Vegetable group	**Milk group**	**Fats and sweets**
½ cup of chopped raw or cooked vegetables	1cup of milk or ½ yogurt	2 teaspoons sugar
1 cup of raw leafy vegetables	30g of cheese	2 hardboiled sweets
		10 ml of mayonnaise
		5ml oil, 10ml margarine (medium fat)

PORTION SIZES FOR CHILDREN 2- TO 6-YEAR-OLDS

Grain group	**Fruit group**	**Meat group**
1 slice of bread	1 piece of fruit or melon wedge	30g of cooked lean meat, poultry, or fish.
½ cup of cooked rice or pasta	½ cup of juice	1 egg
½ cup of cooked porridge	½ cup of canned fruit	½ cup of cooked dry beans
½ cup of ready-to-eat cereal	½ cup of dried fruit	2 tablespoons of peanut butter (add one fat exchange)
1/3 cup samp		
Vegetable group	**Milk group**	**Fats and sweets**
½ cup of chopped raw or cooked vegetables	½ cup of milk or ¼ cup of yogurt	2 teaspoons sugar
1 cup of raw leafy vegetables	60g of cheese	2 hardboiled sweets
		10 ml of mayonnaise
		5ml oil, 10ml margarine (medium fat)

APPENDIX D

Assuring Health for All (AHA) in the Free State

24 Hour Physical Activity Recall

Town: _____ | | | | | | 1

Household number: | | | | | | 2-5

Member number: | | | | 6-7

Interviewer:_____ | | | | 8-9

Time of day	Activity (Number): Use attached coding list					
12:00-12:30 AM			,			
12:30-1:00			,			
1:00-1:30			,			
1:30-2:00			,			
2:00-2:30			,			
2:30-3:00			,			
3:00-3:30			,			
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9:30-10:00			,			
10:00-10:30			,			
10:30-11:00			,			
11:00-11:30			,			
11:30-12:00 PM			,			
12:00-12:30			,			
12:30-1:00			,			
1:00-1:30			,			
1:30-2:00			,			
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9:00-9:30			,			
9:30-10:00			,			
10:00-10:30			,			
10:30-11:00			,			
11:00-11:30			,			
11:30-12:00 PM			,			

Total PAL Value (A) | | , | | | | 10-14

For activities **not reported in the recall**, complete the frequency of the following:

Activity	Duration	Times/day	Times/week	Average/day	PAL/hr
Carrying heavy Items					,
Chopping wood					,
Driving a car					,
Food preparation					,
Gardening (watering)					,
Gardening (no lifting)					,
Gardening (mowing)					,
Housework					,
Playing soccer					,
Riding a bicycle					,
Riding in a car/bus/taxi					,
Running					,
Shopping					,
Skipping rope					,
Total PAL value B					,

Total PAL Value (B) | | , | | | | 15-19

Final PAL Value (A+B) +1.1 | | , | | | | 20-24

PAL Category (according to table below): | | 25

PAL category	PAL values
1. Sedentary	1-1.39
2. Low active	1.4-1.59
3. Active	1.6-1.89
4. Very active	1.9-2.5

Intensity and Impact of Various activities on Physical Activity Levels in Adults

(derived from Carroll & Johnson, 2004, Table 2-4, p. 33)

	PAL/10 min	PAL/30 min
Bath/shower/washing yourself	0.005	0.015
Chopping wood	0.037	0.111
Driving a car	0.005	0.015
Eating	0.005	0.015
Food preparation	0.014	0.042
Gardening - watering plants	0.014	0.042
Gardening – no lifting	0.032	0.096
Gardening – mowing lawn	0.033	0.099
Housework (moderate effort) includes washing laundry	0.024	0.072
Playing soccer	0.088	0.264
Riding a bicycle	0.024	0.072
Riding in a car/bus/taxi	0	0
Running/jogging	0.088	0.264
Sitting with light activity	0.005	0.015
Sitting without activity (e.g. watch TV)	0	0
Sleeping	0	0
Walking (3.2 km/h)	0.014	0.042
Walking (4.8 km/h)	0.022	0.066
Weight lifting	0.061	0.183

PAL calculation

(BEE*+TEF**)+Total of PAL/day=Energy expenditure/day
1.0+10%=1.1+ (PAL/day).

*BEE is always 1 and stands for Basal Energy Expenditure
**TEF=Thermic effect of food and is always 10%

Eg. Walk 20min (0.014*2)=0.028Chopped wood 10 min (0.037*1)=0.037
Played soccer 30min (0.088*3)=0264

Add all the Above totals=0.028 + 0.037 + 0.264 = **0.329= Total Daily PAL**

1+0.1+0.329 **= 1.429**

The answer is then an indication of the amount of physical activity per day.

Due to the fact that not all activities will be mentioned in the 24 hour recall, the physical activity frequency form will be used for cross-referencing and incorporating the information by using the following calculations:

Activity PAL x the frequency x duration of activity = Energy expended per week.

This procedure will be followed for all activities and added to get a total PAL per week. The Total PAL /Week will then be divided by 7 to get the average PAL / day, which will then be used in the following formula:

(BEE+TEF)+Total of PAL/day=Energy expenditure/day
1.0+10%=1.1+ (PAL/day).

EG. chop wood 3 times/ week for 10min each
((0.037*1)*3= 0.111. (The average amount of energy spent on chopping wood per week).
Walk for 30min each day
(0.022*3)*7=0.462

0.111+0.462=0.573=Weekly PAL

1+0.1+0. 573=1.673
1.673/7 =**0.239** = daily energy expenditure

You will now have 2 totals, i.e. (1) the amount of energy expended on average per day, using the Physical Activity Frequency and (2) the amount calculated from the 24 hour recall. These 2 totals will then be added and divided by 2 to get the average energy expended per day. This is done to include activities which are not done on a daily basis:

(1.429+0.239) /2 = 0.834

You then compare your answer in the above formula to the amounts as used by Carroll & Johnson (2004b) to determine daily activity level, which is classified into sedentary, low active, active or very active categories (Carroll & Johnson, 2004b), with the Table below:

PAL category	**PAL values**	**Walking equivalence (miles/day at 3-4 mph)**
Sedentary	1-1.39	
Low active	1.4-1.59	1.5, 2.2, 2.9 for PAL = 1.5
Active	1.6-1.89	3, 4.4, 5.8 for PAL = 1.6 5.3, 7.3, 9.9 for PAL = 1.75
Very active	1.9-2.5	7.5, 10.3, 14 for PAL = 1.9 12.3, 16.7, 22.5 for PAL = 2.2 17, 23, 31 for PAL = 2.5

APPENDIX E: Assuring Health for All (AHA) in the Free State
Anthropometry

Town:_____ [ ] 1

Household number: [ ][ ][ ] 2-4

Member number (as on socio-demographic form): [ ][ ] 5-6

Interview Date: **D D M M Y Y Y Y** [ ][ ][ ][ ][ ][ ][ ][ ] 7-14

Measurer (interviewer):_____ [ ][ ] 15-16

Weight (kg):_____ [ ][ ][ ].[ ] 17-21

Height (cm): _____ [ ][ ][ ].[ ] 22-26

If height cannot be measured:

Knee height (cm):_____ [ ][ ][ ].[ ] 27-31

Demispan (cm):_____ [ ][ ][ ].[ ] 32-36

Circumferences (cm):

Upper-arm (adults and children):_____ [ ][ ].[ ] 37-40

Waist (adults): _____ [ ][ ][ ].[ ] 41-45

Hip (adults): _____ [ ][ ][ ].[ ] 46-50

Wrist (adults):_____ [ ][ ].[ ] 51-54

Head circumference (children):_____ [ ][ ].[ ] 55-58

Bio-impedance fat percentage (adults):_____ [ ][ ].[ ] 59-62

Skinfold thicknesses (mm):

Triceps (adults and children):_____ _____ _____ [ ][ ] 63-64

Biceps (adults): _____ _____ _____ [ ][ ] 65-66

Supra-ileac (adults): _____ _____ _____ [ ][ ] 67-68

Subscapular (adults): _____ _____ _____ [ ][ ] 69-70

Thigh (adults): _____ _____ _____ [ ][ ] 71-72

Calf (adults): _____ _____ _____ [ ][ ] 73-74

APPENDIX F: Assuring Health for All (AHA) in the Free State

HEALTH QUESTIONNAIRE

(All information in this questionnaire is confidential)

Town:_____ 1

Household number: 2-5

Member number (as on socio-demographic form): 6-7

Interviewer: _____ 8-9

Interview Date: D D M M Y Y Y Y 10-17

Marital status: 18

1. Child
2. Never married
3. Currently married/ Traditional marriage
4. Living with partner
5. Widowed
6. Separated
7. Divorced
8. Other, specify_____

Which best describes your history of smoking? 19

1. Never smoked
2. Currently smoke
3. Formerly smoked

If yes, how many cigarettes per day?_____ 20-21

If yes, at what age did you start? _____ 22-23

Which best describes your history of snuffing? 24

1. Never used snuff
2. Currently use snuff
3. Formerly used snuff

If yes, how many times per day do you snuff_____ 25-26

If yes, at what age did you start? _____ 27-28

Which best describes your history of alcohol use? 29

1. Never used alcohol products
2. Currently use alcohol products
3. Formerly used alcohol products

If currently, what form of alcohol do you use regularly (at least once a week)? 1=yes 2=no

1. Spirits (rum, whisky, gin, vodka etc.) 30
2. Wine 31
3. Beer 32
4. Homemade beer 33

At least once a month, do you consume >5 alcoholic drinks per day? 1=yes 2=no 34

At what age did you start using alcohol? _____ 35-36

On weekends, how many alcohol-containing drinks do you consume?_____ 37-38

Do you feel tired on Monday after heavy alcohol consumption (more than 5 drinks per day) during the weekend? 1=yes 2=no 39

Usual sleeping habits:

What time do you usually go to bed at night?_____			:			40-44
What time do you usually wake up in the morning?_____			:			45-49
Do you usually take naps during the day? 1=yes 2=no						50

Current disability: 1=yes 2=no

1. Do you have any trouble walking about?	51
2. Do you have trouble seeing someone across the room (with glasses worn)?	52
3. Do you have trouble reading or seeing individual grains of rice/corn on your plate (with glasses)?	53
4. Do you have trouble speaking and being understood?	54
5. Do you have trouble hearing?	55

Have you experienced any of the following in the last six months? 1=yes 2=no

1. Chest pain or tightness with usual activity	56
2. Breathlessness with usual activity	57
3. Cough for at least 2 weeks	58
4. Wheezing or whistling in the chest	59
5. Loose stools/ diarrhoea for at least 3 days	60
6. Vomiting	61
7. Loss of appetite	62
8. Swelling of feet	63
9. Blood in urine	64
10. Involuntary weight loss of > 3 kg	65
11. Skin rash	66
12. Joint pain	67
13. Sexually transmitted diseases	68

Have YOU ever been diagnosed with the following? 1=yes 2=no

1. Diabetes	69
2. High blood pressure	70
3. Stroke	71
4. Heart disease/ Angina/ Heart attack	72
5. Heart failure	73
6. Cancer	74
7. Liver disease/ Hepatitis/ Jaundice	75
8. Lung disease e.g. emphysema or asthma	76
9. Tuberculosis	77
10. HIV/AIDS	78
11. Epilepsy	79
12. Allergy	80

Has a family member (parents, siblings, children) ever been diagnosed with the following? 1=yes 2=no

1. Diabetes	☐	1
2. High blood pressure	☐	2
3. Stroke	☐	3
4. Heart disease/ Angina/ Heart attack	☐	4
5. Heart failure	☐	5
6. Cancer	☐	6
7. Liver disease/ Hepatitis/ Jaundice	☐	7
8. Lung disease e.g. emphysema or asthma	☐	8
9. Tuberculosis	☐	9
10. HIV/AIDS	☐	10
11. Epilepsy	☐	11
12. Allergy	☐	12

Medication

Are you taking medication regularly (ie. at least once per week) 1=yes 2=no ☐ 13

If yes, list the medication that you are currently using (including traditional medicine).

_____	☐☐	14-15
_____	☐☐	16-17
_____	☐☐	18-19
_____	☐☐	20-21
_____	☐☐	22-23
_____	☐☐	24-25
_____	☐☐	26-27
_____	☐☐	28-29

During the past 12 months, have you been hospitalised? 1=yes 2=no	☐	30
If yes, how many times? _____	☐	
If yes, give details (e.g. for specific operation or treatment)_____	☐☐	23-32
If yes, for how many days?_____	☐☐	33-34

For women only: 1=yes 2=no

1. Are you currently pregnant?	☐	35
2. Do you still have periods?	☐	36
3. Have you ever used an injectable contraceptive?	☐	37
4. How many live children have you given birth to?_____	☐	38
5. Did you breastfeed any of your children?	☐	39
6. If yes, at what age (months) did you add anything other than breast milk to the diet?_____	☐☐	40-41

Social situation and stress:

Are you a member of a church?_____ 1=Yes 2=No	☐	42
Do you attend services at least 2x/month? 1=Yes 2=No	☐	43

Stress is defined as feeling irritable or filled with anxiety, or as having sleeping difficulties as a result of conditions at work or at home. How often have you felt stress in the last 2 months? ☐ 44

1. Never
2. A few periods of stress
3. Several periods of stress
4. Permanent stress

Have you experienced any of the following during the past 12 months? 1=yes 2=no

1. Loss of job	☐	45
2. Retirement	☐	46
3. Loss of crop/ business failure	☐	47
4. Household break in	☐	48
5. Marital separation/ divorce	☐	49
6. Other major intra-family conflict? If yes, specify _____	☐	50
7. Major personal injury or illness	☐	51
8. Violence	☐	52
9. Death of a spouse	☐	53
10 Death or major illness of another family member	☐	54
11. Wedding of family member	☐	55
12. New job	☐	56
13. Birth in the family	☐	57
14. Separation from family	☐	58
15. Unavailability of food/ Food insecurity	☐	59
16 Other major stress? If yes, specify _____	☐	60

During the past 12 months, was there ever a time when you felt sad, blue or depressed for two weeks or more in a row? 1=yes 2=no ☐ 61

Are you willing to answer questions related to HIV/AIDS? 1=yes 2=no ☐ 62

If yes, do you know people who have HIV/AIDS? 1=yes 2=no ☐ 63

If yes, which of these people: 1=yes 2=no

1. Your children	☐	64
2. Your grandchildren	☐	65
3. Your spouse	☐	66
4. Your family members	☐	67
5. Your friends	☐	68
6. People in the community	☐	69

Do you care for orphans in your household? 1=yes 2=no ☐ 70

APPENDIX G: Assuring Health for All (AHA) in the Free State
Medical examination

(All information in this questionnaire is confidential)

Town:_____ 1

Household number: 2-5

Member number (as on socio-demographic form): 6-7

Interviewer: _____ 8-9

Interview Date: D D M M Y Y Y Y 10-17

Blood pressure: (Right arm supine; systolic / diastolic mmHg) 18-23

Heart rate (bpm) 24-26

1. Are any of the following visible/tangible?

Jaundice	Yes (1)	No (2)	27
Anaemia (Pale)	Yes (1)	No (2)	28
Clubbing	Yes (1)	No (2)	29
Cyanosis	Yes (1)	No (2)	30
Lymphadenopathy	Yes (1)	No (2)	31
Oedema	Yes (1)	No (2)	32

2. Are there any cardiovascular abnormalities? Yes (1) No (2) 33

If yes, specify 1._____ 34-35

_____

2. _____ 36-37

_____

3. Are there any respiratory abnormalities? Yes (1) No (2) 38

If yes, specify 1._____ 39-40

_____

2. _____ 41-42

_____

4. Is there any abdominal pathology? Yes (1) No (2) 43

If yes, specify 1._____ 44-45

_____

2. _____ 46-47

_____

5. Are there any nervous system abnormalities? Yes (1) No (2) 48

If yes, specify 1._____ 49-50

_____

2. _____ 51-52

_____

6. Is there any skin pathology? Yes (1) No (2) 53

If yes, specify 1._____ 54-55

_____

2. _____ 56-57

_____

Comments:

_____
_____
_____
_____

_____ _____
Ondersoeker / Examiner **Datum / Date**

PRE-TEST CONSENT TO HIV TESTING

To be completed by the patient/ client:

Do you know what AIDS is?	Yes	No
Has it been explained to you how the test is done?	Yes	No
Have the advantages of the test been explained?	Yes	No
Have the disadvantages of the test been explained?	Yes	No
Has it been explained to you how a positive result will affect your treatment?	Yes	No
Has it been explained to you what will happen if you are not tested?	Yes	No
Do you want to know the result of your HIV test?	Yes	No

To be completed by the counselor:

Have you explained to the patient/ client:

What AIDS is?	Yes	No
How the test will be done?	Yes	No
What the advantages of testing are?	Yes	No
What the disadvantages of testing are?	Yes	No
Why the information is needed?	Yes	No
How a positive result will affect treatment?	Yes	No
What will happen if the test is not done?	Yes	No
Have you yourself explained the above?	Yes	No
Has a translator been used to explain the above?	Yes	No

_____ _____
Signature of Participant Date

_____ _____
Signature of Counselor Date

For children:

_____ _____
Name/ Signature of Child Date

_____ _____
Signature of Parent Date

APPENDIX H: Assuring Health for All (AHA) in the Free State

CONTRACT BETWEEN UNIVERSITY OF THE FREE STATE AND FIELD WORKER

You have been asked to assist in obtaining informed consent from participants to participate in a research study in your town.

You may contact Dr Corinna Walsh at 083 297 6030 at any time if you have questions about the research.

If you agree to assist in obtaining infomed consent from members of the community where you live, the following will be expected from you:

- You should visit approximately 15 households in your area (as divided during the training session) where you need to explain the purpose of the research according to the information document that accompanies the informed consent form.
- After the community member has agreed to participate, they need to sign the infomed consent form (one form for each of the one or two adults that agree to participate as well as a form for each pre-school child in the household, signed by the parent/caregiver of the child).
- You can leave the information document with the community members, but need to collect all the signed consent forms for the researchers (keep them with you until the day of the research).
- You need to give the family a form on which the day that they will be attending the research is indicated and explain that they should not eat or drink anything on the morning that they will be attending the research unit.
- You need to accompany the family for which you have obtained consent to the research unit early on the day that they need to attend together with their signed consent forms.

You will be paid an amount of R200 when all the families for which you are responsible (about 15 families) have been brought to the research unit with their signed forms.

_____ _____

Signature of Fieldworker Date

_____ _____

Signature of Project leader Date

Assuring Health for All (AHA) in the Free State

KONTRAK TUSSEN DIE UNIVERSITEIT VAN DIE VRYSTAAT EN VELDWERKER

U is gevra om ons behulpsaam te wees met die verkryging van ingeligte toestemming van deelnemers wat instem om deel te neem aan ‘n navorsingstudie in u dorp.

U kan ten enige tyd vir Dr Corinna Walsh by 083 297 6030 kontak indien u vrae het in verband met die navorsing.

Indien u toestem om behulpsaam te wees met die verkryging van ingeligte toestemming vanaf lede van u gemeenskap, sal die volgende van u verwag word:

- U moet ongeveer 15 huishoudings in u area (soos verdeel tydens die opleidingsessie) besoek, waar u die doel van die navorsing moet verduidelik volgens die inligtingsdokument wat die ingeligte toestemmingsvorm vergesel.
- Nadat die gemeenskapslid ingestem het om deel te neem aan die navorsing, moet hulle die ingeligte toestemmingsvorm teken (een vorm vir elk van die een of twee volwassenes wat ingestem het sowel as ‘n vorm vir elke voorskoolse kind in die huishouding, geteken deur die ouer of versorger van die kind).
- U kan die inligtingsdokument by die gemeenskapslid laat, maar moet die getekende ingeligte toestemmingsvorms saam met u neem vir die navorsers (hou die vorms by u tot die dag van die navorsing).
- U moet vir die gesin ‘n vorm gee waarop die dag van die navorsing aangedui is en verduidelik dat hulle die oggend waarop hulle aan die navorsing gaan deelneem niks moet eet of drink nie.
- U moet die huishoudings vir wie u ingeligte toestemming verkry het vroeg op die dag wat hulle moet deelneem aan die projek vergesel na die navorsingseenheid (saal) tesame met hul getekende ingeligte toestemmingsvorms.

U sal ‘n bedrag van R200 ontvang wanneer u alle gesinne waarvoor u verantwoordelik is (ongeveer 15 gesinne) na die navorsingseenheid gebring het met hulle getekende ingeligte toestemmingsvorms.

_____ _____

Handtekening van Veldwerker Datum

_____ _____

Handtekening van Projekleier Datum

APPENDIX I: Assuring Health for All (AHA) in the Free State

CONSENT TO PARTICIPATE IN RESEARCH

You have been asked to participate in a research study.

You have been informed about the study by …….. .

You may contact Dr Corinna Walsh at 083 297 6030 at any time if you have questions about the research or if you are injured as a result of the research.

You may contact the Secretariat of the Ethics Committee of the Faculty of Health Sciences, UFS at telephone number (051) 4052812 if you have questions about your rights as a research subject.

Your participation in this research is voluntary, and you will not be penalized or lose benefits if you refuse to participate or decide to terminate participation.

If you agree to participate, you will be given a signed copy of this document as well as the participant information sheet, which is a written summary of the research. You are also giving permission that some of the same blood can be retained in storage for possible future research related to the present research question.

The research study, including the above information has been verbally described to me. I understand what my involvement in the study means and I voluntarily agree to participate.

_____ _____

Signature of Participant Date

For children:

_____ _____

Name/ Signature of Child Date

_____ _____

Signature of Parent Date

Assuring Health for All (AHA) in the Free State
INFORMATION DOCUMENT

Study title: Assuring Health for All (AHA) in the Free State

Thank you for being willing to help us in this very important project. We are sure that the project will contribute to improving the health of all the people of the Free State.
We, the University of the Free State, Faculty of Health Sciences, are doing research on determining the factors involved in causing disease and disability in the Southern Free State. Research is just the process to learn the answer to a question. In this study we want to learn what factors need to be addressed in health programmes in the Free State. The study involves research and is not part of routine medical care.

Invitation to participate: We are asking/inviting you to participate in this research study, or/and asking for your permission to include your child in this research study.

What is involved in the study: The aim of the project is to get enough information regarding the development of chronic diseases like diabetes, stroke, high blood pressure and heart disease as well as HIV/AIDS to plan appropriate health and nutrition intervention strategies for the people of the Free State. Trompsburg, Philippolis and Springfontein have been chosen as the rural areas and Mangaung as the urban area.

For this study we need households whom we can follow for 12 years. The baseline survey will be done from March 2007 to November 2007. You will be asked to visit the nearest research site for one day to take the necessary measurements and to complete the questionnaires. After the baseline survey has been completed, we will implement a nutrition intervention in your community to address the problems identified in the baseline survey. This intervention will form part of the service learning interventions of the University. In addition to the services that we will render in the community, we will visit your community again after three to six years to repeat the measurements.

All the questionnaires will be filled out at the nearest research site or at your household by students from the University of the Free State or by trained research field workers who are from your communities. Respondents from the chosen households will be asked to complete the following questionnaires in an interview with the student or field worker:

- Socio-demographic and household questionnaire,
- Household food security and food procurement questionnaire,
- Health questionnaire,
- Knowledge, practices and attitudes (KPA) about nutrition questionnaire,
- Diet and physical activity questionnaire.

We will also take some measurements such as weight, height, skinfold thicknesses, blood pressure, blood samples and a urine sample. With your permission we will draw 60ml of blood in adults and 15ml in children and this will only be done once. In adults blood and urine samples will be used to determine the following: Full blood count; HbA1c; Glucose; Insulin; Lipogram; Homocysteine; Red cell Folic acid; Serum Vitamin B12; Fibrinogen; Gamma glutermyl transferases (GGT); Carbohydrate-deficient transferrin (CDT); Ferritin; Uric acid; Creatinin; C-reactive protein; Albumin; Pre-albumin; Transferrin; Retinol-binding protein; TSH; Iodine (urine); Leptin; Tumour Necrosis Factor alpha; Interleuken 6; Melatonin; Brain natriuretic peptide; ACTH; Cortisol; Orexin; Urotensin-11; Endothelin 1; Plasminogen Activation Inhibitor (PAI-1); Adiponectin; Micro-albuminuria (urine); Glucose tolerance (sub-sample); FFA (sub-sample).

A short medical examination will be performed on some household members to identify any serious health problems.

We would like to retain some of the same blood in storage for possible future research related to the present research question. Blood samples will be stored anonymously for a period of five years at the Department of Chemical Pathology at the University of the Free State. If you are unhappy to have your blood stored for future research, it will be disposed of at the end of the

study, once the sample storage and record-keeping requirements of good research practice have been met.

It is very important that we gather quality data and knowledge. Because HIV/AIDS is a devastating illness and affects almost all aspects of health, it is necessary to know if HIV is absent before we analyse the data. It will be to your benefit as well as the benefit of the research to determine your HIV status. Therefore we will also ask permission to draw blood to determine your HIV status and ask questions about your HIV status which you are allowed not to answer. You will be asked to sign a separate consent form for the HIV test. You will receive pre- and post-testing counselling by a medical practitioner and all results will be kept strictly confidential in accordance with the guidelines of the Health Professions Council of South Africa (HPCSA). You will only be informed of your HIV result if you choose to be. All respondents who choose to be informed of the results will be informed by a medical doctor and referred for relevant management. None of the researchers (other than one doctor) will know the HIV status of any participants.

Blood tests will involve an analysis of the genetic composition of red blood cells and are aimed at increasing the understanding of the causes and behaviour of chronic diseases of lifestyle such as obesity, diabetes and heart disease. Genes are what you inherit from your parents. They are found in every part of your body and therefore they will be present in the blood that we draw. The findings may benefit/eventually benefit others in terms of prevention or treatment of diseases. You are free to refuse consent and you do not have to give reasons for doing so. The following arrangements have been made to ensure privacy and confidentiality of your genetic information: All blood samples will be stored anonymously at the Department of Chemical Pathology at the University of the Free State. Your genetic material and information will be used in an identifiable form. The research may reveal information of potential importance to the future health of an identifiable or potentially identifiable participant or the participant's offspring.

Researchers will endeavour to provide information about the outcome of the research. If research generates information about you which may be of relevance to the health of other family members, your consent will be sought before offering to disclose such information to the family members concerned. Your material and information will not be released for other uses without consent, unless required by law.

Risks of being involved in the study: Medical doctors or registered nurses will be responsible for safely drawing blood samples. In the unlikely event that an adverse event results from the procedure, you will be compensated for any expenses.
Benefits of being in the study: By participating in the study you will help us to develop health and nutrition strategies that will benefit the people of the Free State. You will be given pertinent information on the study while involved in the project and after the results are available.

Participation is voluntary, and refusal to participate will involve no penalty or loss of benefits to which you are entitled; you may discontinue participation at any time without penalty or loss of benefits to which you are otherwise entitled.
Confidentiality: Efforts will be made to keep personal information confidential. Absolute confidentiality cannot be guaranteed. Personal information may be disclosed if required by law. Organizations that may inspect and/or copy your research records for quality assurance and data analysis include groups such as the Ethics Committee for Medical Research and the Medicines Control Council. If results are published, this may lead to individual/cohort identification.

Kind regards

Dr CORINNA WALSH
Contact details: 083 297 6030 / 051 4013818(W)

Assuring Health for All (AHA) in the Free State

TOESTEMMING TOT DEELNAME AAN NAVORSING

U is versoek om aan ‘n navorsingstudie deel te neem.
U is oor die studie ingelig deur …….. .

U kan Dr Corinna Walsh enige tyd kontak by 083 297 6030 indien u vrae oor die navorsing het of as gevolg van die navorsing beseer is.

U kan die Sekretariaat van die Etiekkomitee van die Fakulteit Gesondheidsweteskappe, UV by telefoonnommer (051) 4052812 kontak indien u enige vrae het oor u regte as ‘n proefpersoon.

U deelname aan hierdie navorsing is vrywillig, en u sal nie gepenaliseer word of voordele verbeur as u weier om deel te neem of besluit om deelname te staak nie.

As u instem om deel te neem, sal ‘n ondertekende kopie van hierdie dokument sowel as die deelnemerinligtingsblad, wat ‘n geskrewe opsomming van die navorsing is, aan u gegee word .

Die navorsingstudie, insluitend die bogenoemde inligting is verbaal aan my beskryf. Ek begryp wat my betrokkenheid by die studie beteken en ek stem vrywillig in om deel te neem.

_____	_____
Handtekening van deelnemer	Datum

Vir kinders:

_____	_____
Naam/ Handtekening van kind	Datum
_____	_____
Handtekening van ouer	Datum

INLIGTINGSDOKUMENT

Studietitel: Assuring Health for All (AHA) in the Free State

Dankie dat u bereid is om ons te help met hierdie baie belangrike projek. Ons is seker dat die projek sal bydra om die gesondheid van alle persone in die Vrystaat te verbeter. Ons, die Universiteit van die Vrystaat, Fakulteit Gesondheidswetenskappe, doen navorsing oor die faktore wat betrokke is by die oorsake van siekte in die Vrystaat. Navorsing is slegs die proses waardeur die antwoord op 'n vraagstuk verkry word. In hierdie studie wil ons leer watter faktore aangespreek moet word in gesondheidsprogramme in die Vrystaat. Die studie behels navorsing en is nie deel van roetine mediese behandeling nie.

Uitnodiging om deel te neem: Ons versoek/nooi u uit om aan 'n navorsingstudie deel te neem of/en vra u toestemming om u kind by die navorsingstudie in te sluit.

Wat behels die studie – Die doelwit van hierdie projek is om genoeg inligting in te samel oor die ontwikkeling van chroniese siektes soos diabetes, beroerte, hoë bloeddruk en hartsiektes sowel as MIV/VIGS om toepaslike gesondheids- en voedingintervensie strategieë te kan beplan vir die mense van die Vrystaat. Trompsburg, Philippolis en Springfontein is as die plattelandse areas gekies en Mangaung as die stedelike area.

Vir die studie benodig ons huishoudings wat ons vir 12 jaar kan opvolg. Die basislyn opname sal in plattelandse areas gedoen word tussen Maart en November 2007. U sal gevra word om die navorsingspunt (saal) naaste aan u vir een dag te besoek waar die nodige metings gedoen sal word en vraelyste voltooi sal word. Nadat die basislynopname voltooi is, sal ons 'n voedingintervensieprogram in u area implementeer om die probleme wat in die basislynopname identifiseer is aan te spreek. Hierdie intervensie vorm deel van die diensleer intervensies van die universiteit. Tesame met die intervensie sal ons ook die gemeenskap elke drie jaar tot ses jaar besoek om die metings te herhaal.

Al die vraelyste sal by u naaste navorsingspunt (saal) of by u huishouding voltooi word deur studente van die Universiteit van die Vrystaat of deur opgeleide navorsingsveldwerkers van u gemeenskap. Respondente van die gekose huishoudings sal gevra word om die volgende vraelyste te voltooi in 'n onderhoud met die student of veldwerker:

- Sosio-demografiese en huishoudelike vraelys,
- Huisehoudelike voedselsekuriteit en voedselverkrygings vraelys,
- Gesondheids vraelys,
- Kennis, praktyke en houding teenoor voeding vraelys,
- Dieet en fisiese aktiwiteit vraelys.

Ons sal ook sekere metings soos gewig, lengte, velvoudiktes, bloeddruk, bloed monsters en uriene monsters neem. Met u toestemming sal ons in volwassenes 60ml bloed trek en in kinders 15ml en dit sal slegs een keer geskied. In volwassenes sal bloed en uriene monsters gebruik word om die volgende te bepaal: Volbloedtelling; HbA1c; Glukose; Insulien; Lipogram; Homositeïen; Rooisel Folaat; Serum Vitamien B12; Fibrinogeen; Gamma glutermyl transferases (GGT); Carbohydrate-deficient transferrin (CDT); Ferritin; Uriensuur; Kreatinien; C-reactiewe proteïen; Albumien; Pre-albumien; Transferrien; Retinol-binding proteïen; TSH; Jodium (uriene); Leptien; Tumor Nekrosis Faktor alfa; Interleuken 6; Melatonien; Brain natriuretic peptide; ACTH; Kortisol; Orexin; Urotensien-11; Endothelien 1; Plasminogen Activation Inhibitor (PAI-1); Adiponektien; Mikro-albumienuria (uriene); Glukose toleransie (sub-sample); FFA (sub-sample).
'n Kort mediese ondersoek sal ook gedoen word op sekere lede van die huishouding om ernstige gesondheidsprobleme te identifiseer.

Ons wil graag van die bloed bêre vir moontlike toekomstige navorsing wat verband hou met die huidige navorsingsvrae. Bloed monsters sal anoniem gestoor word vir 'n periode van vyf jaar by die Departement Chemiese Patologie by die Universiteit van die Vrystaat. As u ongelukkig daaroor voel dat u bloed vir toekomstige navorsing geberg word sal daar aan die einde van die

studie daarmee weggedoen word sodra die monsterbergings- en aantekeningsvereistes van goeie navorsingspraktyk nagekom is.

Dit is baie belangrik dat ons inligting van ‘n hoë kwaliteit versamel. Omdat MIV/VIGS ‘n siekte is wat amper alle aspekte van gesondheid beïnvloed, is dit nodig dat ons weet of MIV afwesig is voordat ons die data ontleed. Dit sal tot voordeel van uself en die navorsing strek indien u HIV status bepaal kan word. Dus sal ons toestemming vra om bloed te trek om u MIV status te bepaal en vrae oor HIV vra wat u nie hoef te antwoord indien u nie wil nie. U sal gevra word om ‘n aparte teostemmingsvorm te voltooi vir die HIV toets. U sal voor en na die toets berading ontvang deur ‘n mediese dokter en alle uitslae sal streng vertroulik hanteer word volgens die riglyne van die Health Professions Council of South africa (HPCSA). U sal slegs van u MIV uitslae in kennis gestel word indien u kies om dit te ontvang. Alle respondente wat kies om van hulle uitslae in kennis gestel te word sal deur ‘n mediese dokter in kennis gestel word en verwys word vir die relevante hantering. Die navorsers (met uitsluiting van een dokter) sal nie weet wat u uitslae is nie.

Bloedtoetse sal die analise van die genetiese samestelling van rooibloedselle insluit en is gemik daarop om die oorsake en gevolge van chroniese siektes soos vetsug, diabetes en hartsiektes beter te verstaan. Gene is dit wat u van u ouers erf en word in elke deel van u liggaam aangetref. Daarom sal dit in enige weefsel of bloed wat deur ons verwyder word teenwoordig wees. Die bevindings kan tot ander se voordeel strek met betrekking tot voorkoming en behandeling van die toestand. Dit staan u vry om toestemming te weier en u hoef geen redes daarvoor te verstrek nie. Die volgende reëlings is getref om privaatheid en vertroulikheid van u genetiese inligting te verseker: Alle bloedmonsters sal anoniem geberg word by Departement Chemiese Patologie by die Universiteit van die Vrystaat. U genetiese materiaal en inligting sal in ‘n identifiseerbarevorm gebruik word. Die navorsing mag inligting openbaar wat van potensiële belang mag wees vir die toekomstige gesondheid van ‘n identifiseerbare of potensieel identifiseerbare deelnemer of die deelnemer se nakomelinge.

Navorsers sal poog om inligting oor die uitkoms van die navorsing te verskaf. As navorsing inligting aan die lig bring wat van belang mag wees vir die gesondheid van u familielede, sal u toestemming verkry word voordat sodanige inligting aan die betrokke familielede bekend gemaak word. U bloed en inligting sal nie sonder toestemming vir ander gebruike beskikbaar gestel word nie tensy vereis deur die wet.

Risikos van deelname aan die studie: Mediese dokters of geregistreerde verpleegkundiges sal verantwoordelik wees vir die veilige neem van bloedmonsters. In die onwaarskynlike geval dat ‘n negatiewe gevolg ontstaan as gevolg van die prosedure sal u vir enige onkostes vergoed word.
Voordele van deelname aan die studie: Deur aan die studie deel te neem sal u ons help om gesondheids- en voedingstrategieë te ontwikkel wat die mense van die Vrystaat sal baat. Die proefpersoon sal pertinente inligting oor die studie ontvang tydens betrokkenheid by die projek en agterna wanneer die resultate beskikbaar is.

Deelname is vrywillig, en weiering om deel te neem sal geen boete of verlies van voordele waarop die deelnemer andersins geregtig is behels nie; die proefpersoon kan te eniger tyd aan deelname onttrek sonder boete of verlies van voordele waarop die proefpersoon andersins geregtig is.
Vertroulikheid: Daar sal gepoog word om persoonlike inligting vertroulik te hou. Volkome vertroulikheid kan nie gewaarborg word nie. Persoonlike inligting kan bekend gemaak word as die wet dit vereis. Organisasies wat u navorsingsrekords mag ondersoek en/of kopieer vir kwaliteitsversekering en data-analise sluit groepe soos die Etiekkomitee vir Mediese Navorsing en die Medisynebeheerraad in. As resultate gepubliseer word kan dit lei tot individuele/groepsidentifikasie.

Vriendelike groete

Dr CORINNA WALSH
Kontakbesonderhede: 083 297 6030 / 051 4013818(W)

Assuring Health for All (AHA) in the Free State
(Tshepiso ya Bophelo ho bohle ba Foreisitata)

TUMELLO YA HO NKA KAROLO DIPATLISISONG

O kopuwe ho nka karolo dipatlisisong.

O tsebisitswe ka dipatlisiso tsena ke .....

O ka ikopanya le Dr Corinna Walsh ho 083 297 6030 nako e nngwe le e nngwe ha o na le dipotso ka dipatlisiso kapa ha o ka wa lematseha ka lebaka la dipatlisiso.

O ka ikopanya le mongodi wa komiti ya Ethics ho Faculty ya Health Sciences, Yunivesithing ya Foreisitata nomorong ya (051) 4052812 ha o ena le dipotso ka ditokelo tsa hao jwalo ka motho ya nkang karolo dipatlisisong.

O nka ka karolo dipatlisisong ka ho ithaopa, ka hoo o ke ke wa ahlolwa kapa wa lahlehelwa ke di letho ha o ka wa hana ho nka karolo kapa wa tlohella ho nka karolo.

Ha ebe o dumela ho nka karolo, o tla fuwa lengolo le tshwanang le lena le saenuweng hammoho le lengolo le fanang ka tlhahiso leseding, eo e leng tlhaloso e ngotsweng ya dipatlisiso tsena.

Ke hlaloseditswe sepheo sa dipatlisiso, hammoho le tlhahiso leseding ena e ka hodimo ka molomo. Ke utlwisisa ho nka karolo ha ka dipatlisisong mme ke dumela ho nka karolo ka ho ithaopa, ntle le ho qobellwa.

_____	_____
Signature ya ya nkang karolo	Letsatsi

Bakeng sa bana

_____	_____
Signature ea ngoana	Letsatsi
_____	_____
Signature ea motsoali	Letsatsi

Assuring Health for All (AHA) in the Free State
(Tshepiso ya Bophelo ho bohle ba Foreisitata)

LENGOLO LA TLHAHISO LESEDING

Sehloho sa dipatlisiso: Assuring Health for All in the Free State

Re leboha ha o dumetse ho re thusa dipatlisisong tsena tse bohlokwa. Re tshepa ha dipatlisiso di tla re thusa ho ntlafatsa maphelo a batho bohle ba Foreisitata.
Rona, re le Yunivesithi ya Foreisitata, Lefapha la tsa Maphelo, re etsa dipatlisiso ho shebana le dintho tse bakang mafu le boqhwala mona Foreisitata e Borwa.
Dipatlisiso ke mokgwa wa ho ithuta karabo ya potso e itseng. Ka dipatlisiso tsena re batla ho ithuta hore na ke dintho dife tse hlokang hore di amuwe ditsamaisong tsa tsa bophelo mona Foreisitata. Tsena ke dipatlisiso feela, mme ha se karolo ya tshebeletso ya tsa bongaka.

Sememo sa ho nka karolo: Re a o kopa/ re a o mema ho nka karolo dipatlisisong tsena, ebile/ kapa re kopa tumello ya hao ho sebedisa ngwana wa hao dipatlisisong tsena.
Dipatlisiso tsena di kenyeleditse eng: Sepheo sa dipatlisiso tsena ke ho fumana tlhahiso leseding e lekaneng mabapi le tswello pele ya mafu a kang diabetes, stroke, high blood pressure le mafu a pelo hammoho le HIV/AIDS hore ho tle ho thalwe mekgwa ya tsamaiso ya tsa bophelo le phepo bakeng sa batho ba Foreisitata. Trompsburg, Phillippolis le Springfontein di kgethilwe jwalo ka dibaka tsa mahaeng mme Mangaung e kgethilwe e le sebaka sa ditoropong tse tla sebediswang dipatlisisong.
Bakeng sa dipatlisiso tsena re hloka ho sebetsa le malapa ohle motseng wa lona bakeng sa dilemo tse 12. Dipatlisiso tsa pele di tla qala ka Hlakubele (March) 2007 ho isa ho Pudungwana (November) 2007. O tla kopuwa ho etela sebaka seo lipatlisiso tsena li tswaretsoeng teng letsatsi le le leng hore o tle o tsebe ho tlatsa diforomo le hore o methuwe. Kamora dipatlisiso tsena tsa pele, ho kenywa tshebetsong mekgwa ya tlhokomelo mabapi le tsa phepo sebakeng seo o dulang ho sona hore ho tle ho lokisanwe le mathatha a tla be a hlahelletse dipatlisisong tsa pele. Tlhokomelo ena e tla ba karolo ya ho ithuta ho bile ho fanwa ka ditshebeletso ke baithuti ba Yunivesithi. Hammoho le ditshebetso tseo re tla be re fana ka tsona motseng, re tla etela motse wa hao ka mora dilemo tse tharo hoisa ho tse tseletseng hore ho phethwe ho metha.

Diforomo tsohle di tla tlatswa sebakeng seo liphuputso li tla tswareloa teng ke baithuti ba tswang Yunivesithing ya Foreisitata kapa ke bathusi ba kwetlisitsweng ba tswang motseng wa hao. Batho ba nkang karolo ho tswa malapeng a kgethilweng ba tla kopuwa ho tlatsa diforomo tse latelang ho ya ka dipotso tseo ba tla beng ba di botswa ke moithuti kapa mosebeletsi wa setjhaba:

- Dipotso ka maemo a hao le ka lelapa la hao,
- Theko ya dijo le 'food security',
- Tsebo, tshebetso le mekgwa e amanang le phepo,
- Tsela ya ho ja le boikwetliso.

Re tla o metha boima, botelete, botenya ba momeno wa letlalo (skinfold) le kgatello ya madi (blood pressure), o tla nkuwa madi hammoho le metsi. Ho batho ba baholo re tla hula madi a kana ka dimililitara tse 60, mme ho bana re tla hula tse 15, hona ho tla etswa hanngwe feela. Ho tla etswa dihlahlobo tsa bophelo ho batho ba itseng ba lelapa ho shebana le mathata a bophelo a tshosetsang. Ka tumello ea hau re tla ntsa madi a ka bang dimelimetara tse mashome a tseletseng (60ml) ho motho e moholo le tse leshome le metso e mehlano (15ml) ho bana , mme hona ho tla etwa hangoe feela. Madi le metsetse e nkuoeng ho batho ba baholo e tla sebediswa ho hlalhoba matsoai le matsooeana a fumanehang ho tsona a kenyeletsang tse latelang: Full blood count; HbA1c; Glucose; Insulin; Lipogram; Homocysteine; Red cell Folic acid; Serum Vitamin B12; Fibrinogen; Gamma glutermyl transferases (GGT); Carbohydrate-deficient transferrin (CDT); Ferritin; Uric acid; Creatinin; C-reactive protein; Albumin; Pre-albumin; Transferrin; Retinol-binding protein; TSH; Iodine (urine); Leptin; Tumour Necrosis Factor alpha; Interleuken 6; Melatonin; Brain natriuretic peptide; ACTH; Cortisol; Orexin; Urotensin-11; Endothelin 1; Plasminogen Activation Inhibitor (PAI-1); Adiponectin; Micro-albuminuria (urine); Glucose tolerance (sub-sample); FFA (sub-sample). Tse ding tsa matsoai le matsoaeana ana di tla hlahlojoa mading le metsetseng ea bana

Re ka rata ho boloka a mang a madi hore a tle a tsebe ho sebediswa ka nako e tlang dipatlisisong tse tshwanang le tsena. Madi ana a tla bolokwa kantle le ho ngolwa mabitso bakeng sa dilemo tse hlano Lefapheng la Chemical Pathology Yunivesithing ya Foreisitata. Ha o sa rate ha madi a hao a bolokwa bakeng sa dipatlisiso tse ding, a tla lahlwa ha ho qetwa ka dipatlisiso le hang feela ha a ile a bolokwa hantle e bile dintho tse hlokahalang bakeng sa dipatlisiso di ile tsa fumanwa ka mokgwa o nepahetseng.

Ho bohlokwa haholo hore tlhahiso leseding eo re e fumanang ke e hlwahlwa. Hobane lefu la HIV e le le hlokofatsang haholo, ebile le ama maphelo a rona, ho a hlokahala hore re tsebe hore kokwana-hloko ena e teng kapa tjhe. Ke molemong oa hau le oa mofuputse ho fumana boemo ha hau ba HIV. Ka hona re tla kopa tumello ea ho ntsa madi ho uena ho ea hlahloba boemo ba hau ba HIV mme re tla u botsa lipotso tse ling tse amanang le boemo ba hau ba HIV tseo u sa qobelloeng ho li araba. U ka li araba ka ho rata ha hau. U tla kopuoa ho saena foromo eo u re fang tumello ea ho hlahloba boemo ba hau ba HIV. Ka hoo re tla hula madi le ho o botsa dipotso mabapi le maemo a hao a HIV. O dumelletswe ho se arabe dipotso tsena. Ho tla buisanwa le wena ho tebesitswe maikutlo pele le ka mora dihlahlobo tse tla etswa ke ngaka, mme diphetho tsohle di tla ba sephiri ho ya ka ditaelo tsa Health Professions Council ya South Africa (HPCSA). O tla tsebiswa ka maemo a hao a HIV feela ha o kgetha hore o tsebiswe. Batho bohle ba batlang ho tsebiswa ka sephetho sa dihlahlobo tsa HIV, ba tla tsebiswa ke ngaka, mme ba tla romellwa ho batho ba tla tseba ho ba fa thuso. Babatlisisi ba bang (ka ntle ho dingaka) ba ke ke ba tseba maemo a ba nka karolo a HIV.

Ho hulwa ha madi ho kenyelleditse ho hlahloba ‘genetic composition’ e ho di ‘red blood cells’, mme hona ho tla thusa ho phahamisa kutlwisiso ya dintho tse bakang mafu a kang monono, diabetes le mafu a pelo. Di ‘genes’, ke dintho tseo o di futsang ho tswa ho batswadi ba hao. Di fumanwa dikarolong tsohle tsa mmele kahoo di a fumaneha le ho madi a tla hulwa. Dintlha tse tla fumanwa di tla thusa batho ba bang ka ho thusa ho thibela, kapa ho phekola mafu a fapaneng. O na le tokelo ya ho hana ho nka karolo ebile ha ho hlokahale hore o fane ka lebaka. Ho netefatsa hore dintlha tse tla fumanwang ho wena di dula e le sephiri, ho entswe dintho tsena tse latelang: Madi ohle a tla bolokwa ntle le ho ngolwa mabitso Lefapheng la Chemical Pathology Yunivesithing ya Foreisitata. ‘Genetic material’ ya hao e tla sebediswa ka mokgwa o tsebahalang. Dipatlisiso tsena di ka nna tsa fana ka tlhahiso leseding e bohlokwa bakeng sa bokamoso ba monka karolo kapa ba bana ba hae.

Babatlisisi ba tla leka ho fana ka lesedi mabapi le sephetho sa dipatlisiso. Ha dipatlisiso di ka fana ka dinthla tse leng bohlokwa bakeng sa maphelo a ba bang ba lelapa, tumello e tla kopuwa ho wena pele batho ba amehang ba tsebiswa. Dintlha tsohle tsa hao di ke ke tsa sebediswa nqeng tse ding kantle ho tumello ya hao, kantle le ha ho ka hlokeha hore ho etswe jwalo ho ya ka molao.

Kotsi tse ka bang teng dipatlisisong: Dingaka le baoki ba tla ikarabella ho huleng ha madi ka mokgwa o bolokehileng. Ha ho ka etsahala hore ho be le se o etsahallang se sa lokang o tla lefuwa ditshenyehelo tsa hao tsohle.
Ditholwana tsa ho nka karolo: Ha o nka karolo o tla thusa ho tsweletsa pele metjha ya tsa bophelo le phepo ho thusa batho ba Foreisitata. O tla fuwa tlhahiso leseding e bohlokwa tsamaong ya dipatlisiso le ha sephetho sa dipatlisiso se fumaneha.

O nka karolo ka ho ithaopa, mme ha o hana ho nka karolo o ke ke wa lahlehelwa ke letho; o ka tlohella ho nka karolo nako e nngwe le e nngwe ntle le ho lahlehelwa ke letho.
Sephiri: Ho tla etswa maleba-leba a hore dintlha tsa hao di dule di le lekunutu. O tshepiswa lekunutu ka hohle-hohle. Dintlha tsa hao di phatlalatswa feela ha molao o re jwalo. Mekgatlo e tla hlahloba kapa e tla kopisa dintlha tsa hao ho lekola boleng e kenyeleditse e kang Ethics Committee ya Medical Research hammoho le Medicine Control Council.
Ha diphetho di ka phatlalatswa, hona ho ka lebisa ho tsebiswa ha motho kapa sehlopha.

Ka boikokobetso
Dr Corinna Walsh
Mohala: 083 297 6030 / 051 401 3818

APPENDIX J

Assuring Health for All (AHA) in the Free State
Participation letter

Dear Participant

Thank you for being willing to help us in this very important project. We are sure that the project will contribute to improving the health of all the people of the Free State.

At the time you receive this letter you would have already been visited by a fieldworker and you have already signed consent to give a blood sample. This letter serves to inform you of the date and time the blood sample and other measurements will be taken at the research unit (hall) closest to your household.

IMPORTANT INFORMATION

1. You must be at the research unit (hall) in your community on **……** by 0….h00.
2. You **MUST NOT EAT OR DRINK** anything after ten o'clock of the previous night (10 pm of the night before). This is necessary for the glucose test to be accurate.
3. You **MUST BRING YOUR ID DOCUMENT** with you
4. You will receive something to eat and drink after the blood sample is taken.
5. If you are employed, please show this letter to your employer.

Dear Employer

This serves to ask you to give one day's paid leave to…… in order to allow him/her to attend his appointment with the research team of the Faculty of Health Sciences at the University of the Free State.

Thank you for your cooperation. For any further information please contact Dr Corinna Walsh at 083 297 6030.

C Walsh (project leader)

Assuring Health for All (AHA) in the Free State
Deelname brief

Beste Deelnemer

Dankie dat u bereid is om ons te help met hierdie belangrike projek. Ons is seker dat die projek sal bydra tot die verbetering van gesondheid van al die mense in die Vrystaat.

Teen die tyd wat u hierdie brief ontvang het 'n veldwerker u al reeds besoek en u het toestemming gegee om deel te neem aan die projek en 'n bloed monster te gee Met hierdie brief wil ons u graag in kennis stel van die datum en tyd wat die bloed getrek sal word en ander mates geneem sal word by die navorsingseenheid (saal)naaste aan u woning.

BELANGRIKE INLIGTING

1. U moet by die navorsingseenheid (saal) in u gemeenskap wees op **……** teen 0….h00.
2. U **MOET NIKS EET OF DRINK** na tien uur die vorige aand (10 pm van die aand voor die toets). Dit is nodig vir die glukose toets om betroubaar te wees.
3. U **MOET U ID DOKUMENT** saam met u kliniek toe bring
4. U sal 'n ligte ete en iets om te drink ontvang nadat die bloedtoets voltooi is.
5. Indien u werk, moet u asseblief hierdie brief aan u werkgewer wys.

Geagte Werkgewer

Met hierdie brief vra ons dat u een dag betaalde verlof toestaan aan…….
om dit vir haar/hom moontlik te maak om hierdie afspraak met die navorsingsspan van die Fakulteit Gesondheidswetenskappe by die Universiteit van die Vrystaat by te woon.

Dankie vir u samewerking. Vir verdere inligting kontak asseblief vir Dr Corinna Walsh by 083 297 6030.

C Walsh (projekleier)

Assuring Health for All in the Free State
(Tshepiso ya Bophelo ho bohle ba Foreisitata)

Lengolo la ho nka karolo

Ho ya nkang karolo

Re leboha ha o dumetse ho re thusa mosebetsing ona o bohlokwa. Re tshepa ha mosebetsi ona o tla thusa ho ntlafatsa maphelo a batho bohle ba Foreisitata.

Nako eo o fumanang lengolo lena, o tla be o se o etetswe ke e mong wa bathusi ba rona ebile o tla be o se o saenile ho fana ka tumello ya ho hula madi. Lengolo lena ke le o tsebisang ka letsatsi le nako eo tla methwang le ho hulwa madi tliliniking e haufi le lelapa la hao.

DINTLHA TSA BOHLOKWA

1. O tlamehile o be o le tliliniking e motseng wa hao ka di ..... nako e le 0.....h00.
2. **O SE KE WA JA KAPA WA NWA** letho ka mora hora ya leshome(10:00) bosiu bo ka pele ho fihlela o hlahlobuwa tliliniking. Hona ho bohlokwa hore dihlahlobo tsa tswekere e be tse nepahetseng.
3. O **TSHWANETSE HO TLA LE BUKANA YA HAO YA BOITSEBISO (ID)** ha o tla
4. O tla fuwa tjhelete e nyenyane bakeng sa ditshenyehelo tse tla bang teng hore o nke karolo dipatlisisong. O tla fumana dijo kamora hore o hulwe madi.
5. Ha e be o sebetsa, re kopa o bontshe monga hao lengolo lena.

Monga mosebetsi

Lengolo lena le kopa hore of fane ka letsatsi le leng leng le patallwang ho ..... hore a tle a tsebe ho ba teng ka nako eo a e beetsweng bakeng sa sehlopha se etsang dipatlisiso sa Lefapha la tsa maphelo Yunivesithing ya Foreisitata.

Re lebohela tshebedisano mooho ya hao. Ha ebe o hloka tlhalosetso e fetang mona o ka ikopanya le Dr Corinna Walsh ho 083 297 6030.

C Walsh (moetelledipele)

APPENDIX K
Antiretroviral Therapy Treatment Guidelines

Adults and Adolescents

Standardised national eligibility criteria for starting ART regimes for adults and adolescents (DoH, 2013).

Eligible to start Lifelong ART
▪ CD4 count ≤ 350 cells/mm3 irrespective of WHO clinical stage **OR** ▪ Irrespective of CD4 count o All types of TB (in patients with TB drug resistant or sensitive, including extra pulmonary TB) ▪ WHO stages 3 or 4 irrespective of CD4 count
Require fast track (i.e. ART initiation within 7 days of being eligible)
▪ HIV positive women who are pregnant or breast feeding OR ▪ Patients with low CD4 < 200 OR ▪ Patients with Stage 4, irrespective of CD4 count **OR** ▪ Patients with TB/HIV co morbidity with CD4 count < 50 (Patients with Cryptopcoccus meningitis or TB meningitis (defer RT for 4-6 weeks)
Patients with CD4 above 350, not yet eligible for ART
▪ Transfer to a wellness programme for regular follow-up and repeat CD4 testing 6-monthly. ▪ Advise on how to avoid HIV transmission to sexual partners and children. ▪ Initiate INH prophylaxis if asymptomatic for TB. ▪ Provide counseling on nutrition and contraception and do annual pap smear.

3TC Lamivudine
ABC Abacavir
AZT Zidovudine
d4T Stavudine
EFV Efavirenz
FTC Emtricitabine
LPV/r Lopinavir/ritonavir
NVP Nevirapine
TDF Tenofovir

Standardised national ART regimens for adults and adolescents (DoH, 2013)

1st Line		
All new patients needing treatment, including pregnant women	TDF + FTC (or 3TC) + EFV	Replace EFV with NVP in patients with significant psychiatric co morbidity or intolerance to EFV and where the neuro-psychiatric toxicity of EFV may impair daily functioning, e.g. shift workers.
Adolescents	ABC + 3TC + EFV	At age 18 years an adolescent if eligible must be switched to the FDC.
Contraindications to EFV	TDF + (FTC or 3TC) + NVP	Use NVP based regimen in patients with significant psychiatric co morbidity or intolerance to EFV and where the neuro-psychiatric toxicity of EFV may impair daily functioning, e.g. shift workers.
Contraindications to TDF	AZT + 3TC + EFV (or NVP)	Renal disease or the use of other nephrotoxic drug, e.g. aminoglycosides.
Contraindications to TDF and AZT	D4T + 3TC + EFV (or NVP)	Renal disease and anaemia or the use of other nephrotoxic drugs, e.g. aminoglycosides.
Contraindications to TDF, AZT and d4T	ABC + 3TC + EFV (or NVP)	Renal disease, anaemia, peripheral neuropathy, the use of other nephrotoxic drugs.
Currently on d4T-based regimen	TDF + FTC (or 3TC) + EFV FDC preferred	Mandatory if patients experience toxicity and patients who are at high risk of toxicity (high BMI) or pregnant). Switch to TDF if virally suppressed and the patient has normal creatinine clearance, even if well tolerated.
2nd Line		
Management of virological failure		Of plasma HIV RNA > 1000 copies. Check for adherence, compliance, tolerability and drug-drug interaction and assess psychological issues. Repeat VL test 2 months later. If plasma VL confirmed >1000 copies change regime to 2nd line therapy.
Failing on a TDF-based 1st line regimen	AZT + 3TC = LPV/r	Patients with anaemia and renal failure switch to ABC.
Failing on a d4T-based 1st line regimen	TDF + 3TC (or FTC) and LPV/r	
Dyslipidaemia or intractable diarrhoea associated with LPV/r	Switch LPV/r to ATV/r	
3rd Line		
Failing 2nd line regimen	Specialist referral	
Should be expert and genotype resistance testing based decision and supervised care. Patients failing on 2nd line therapy will be managed by an expert panel. The drugs for 3rd line will be managed centrally. More discussion is required to deal with the modalities.	Most likely regimen: Raltegravir/Darunavir/Etravirine adjusted according to genotype interpretation. Should be by expert and take into account prior exposure and predictable mutations.	

Standardised national monitoring for adults and adolescents with HIV (DoH, 2013)

At initial diagnosis of HIV	Purpose
Confirm HIV result with rapid antibody test	Ensure that national testing algorithm has been followed
Do CD4 count of HIV positive and WHO clinical staging	To assess eligibility for ART To access eligibility for fast-tracking
Screen for pregnancy or ask if planning to conceive	To identify women who need ART for life or ARV prophylaxis for PMtCT
Screen for TB symptoms using the WHO questionnaire	To identify TB/HIV co-infected
Do the CD4 count on the same day	To identify for ART or ARVs for prophylaxis if pregnant
Do HB or FBC if requires AZT Creatinine if requires TDF For patients initiated on NVP based regime do ALT	To detect anaemia or neutropenia To detect renal insufficiency To exclude liver disease

On ART	Purpose
CD4 at 1 year on ART	To monitor immune response to ART
VL at months 6, 1 year on ART and then every 12 months	To identify treatment failures and problems with adherence
ALT only if on NVP and develops rash or symptoms of hepatitis	To identify NVP toxicity
FBC at month 3 and 6 if on AZT	To identify AZT toxicity
Creatinine at month 3 and 6, 1 year then every 12 months if on TDF	To identify TDF toxicity
Fasting cholesterol and triglycerides at months 3 if on LPV/r	To identify LPV/r toxicity

At routine follow-up visits for those not yet eligible for ART	Purpose
Repeat CD4 count at 6 months	To see if they have become eligible for ART
WHO clinical staging at every visit	To see if they have become eligible for ART
Screen for TB symptoms to identify TB suspects Offer IPT if no TB symptoms	To identify TB/HIV co-infection To prevent TB activation
Offer prevention for HIV positives	To prevent HIV transmission and re-infection To prevent STIs

Indications for urgent up-referral prior to initiation or when on therapy

- eGFR less than 60 ml/min
- Hb less than 8 g/dl
- BMI less than 18.5 kg/m^2
- In patient with TB or other opportunistic infection, poor response to TB or OI treatment